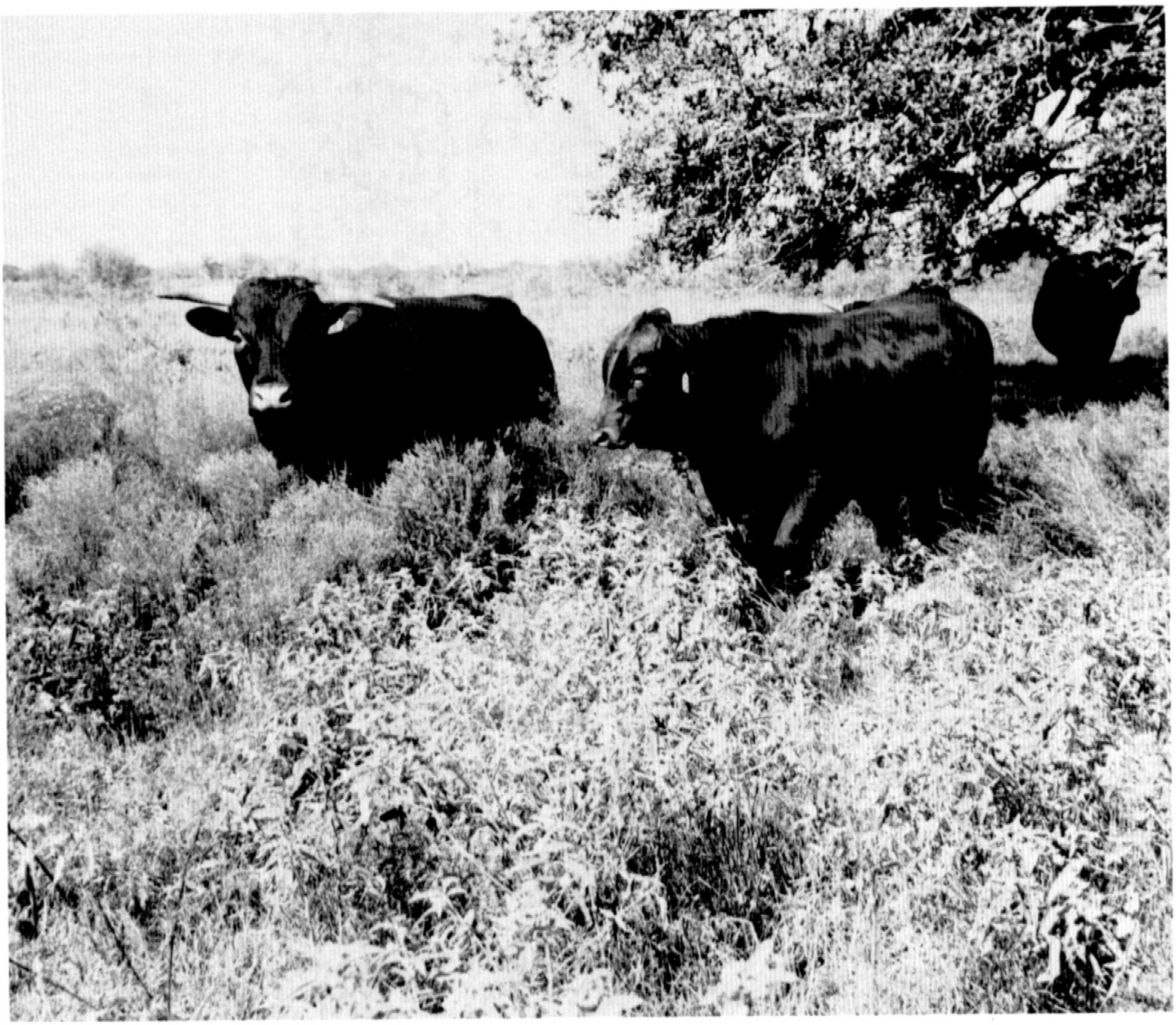
United States
Department of
Agriculture

Soil
Conservation
Service

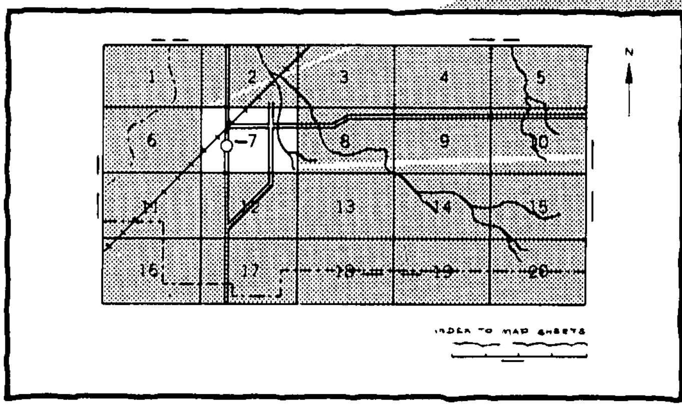
In cooperation with
Texas Agricultural
Experiment Station and
Texas State Soil and
Water Conservation Board

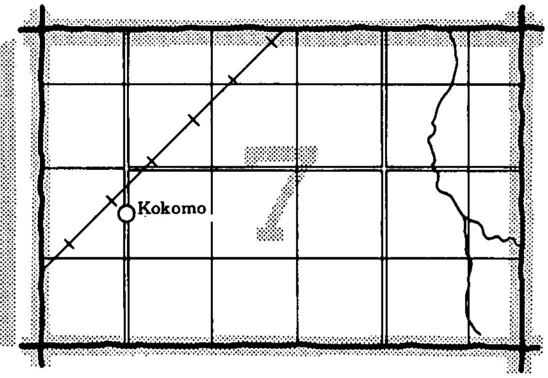
Soil Survey of Refugio County Texas



HOW TO USE

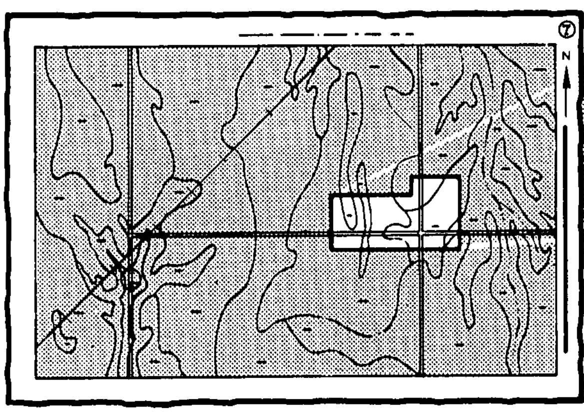
1. Locate your area of interest on the "Index to Map Sheets."

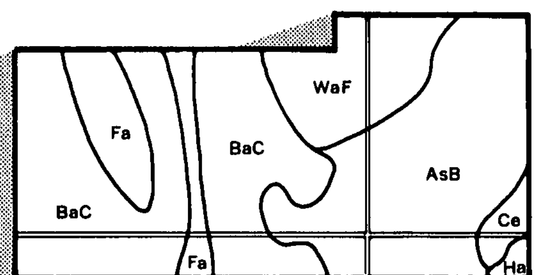




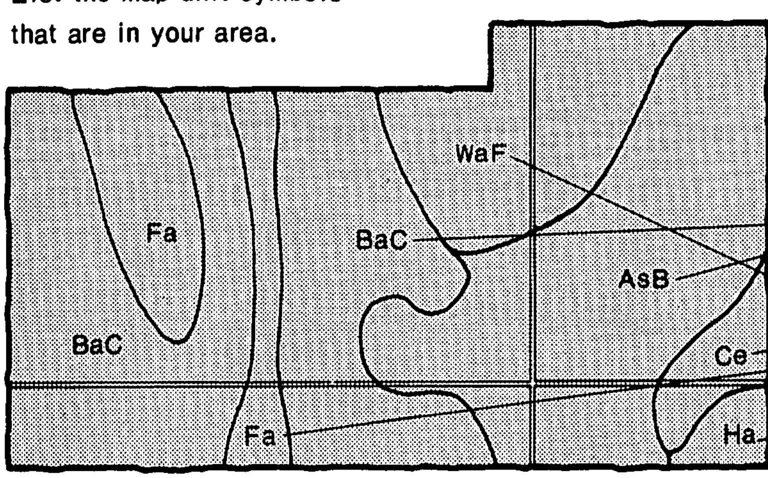
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area.

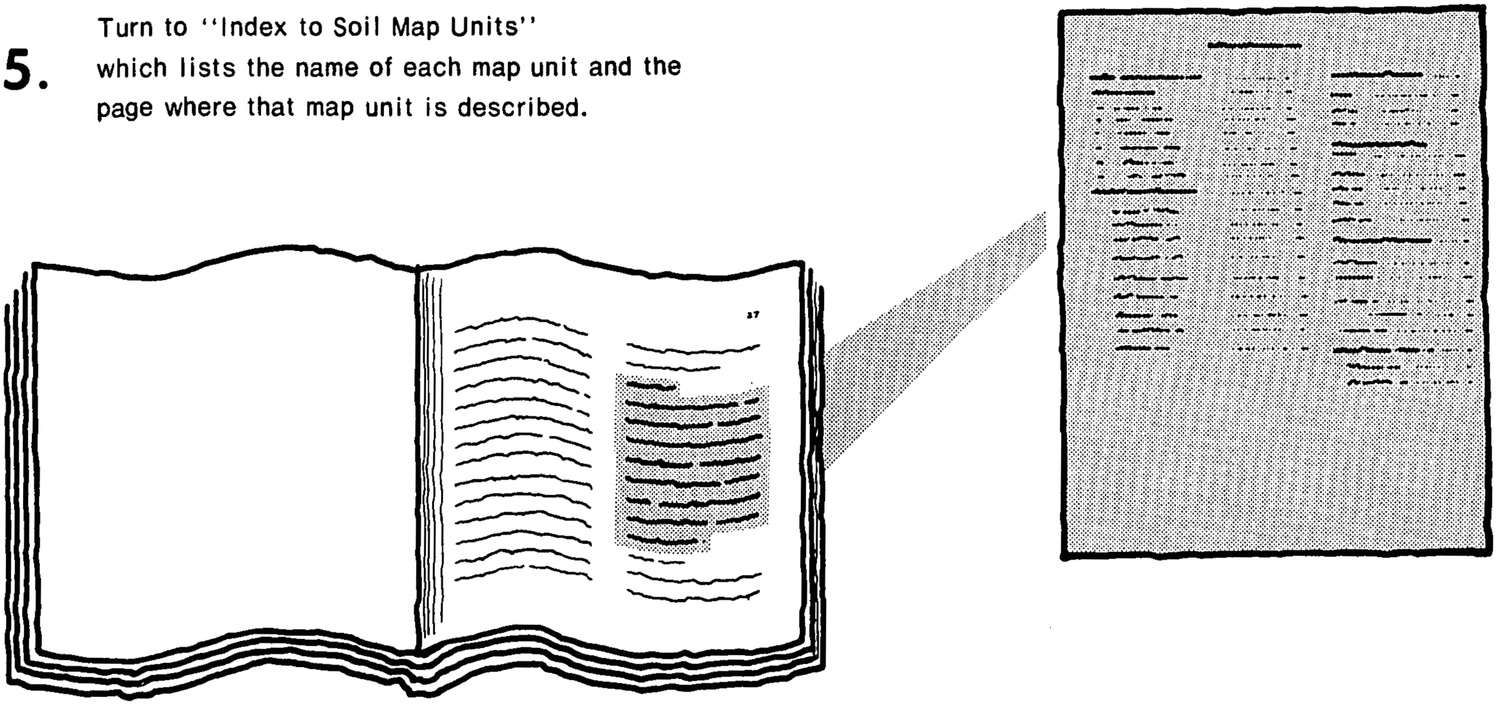


Symbols

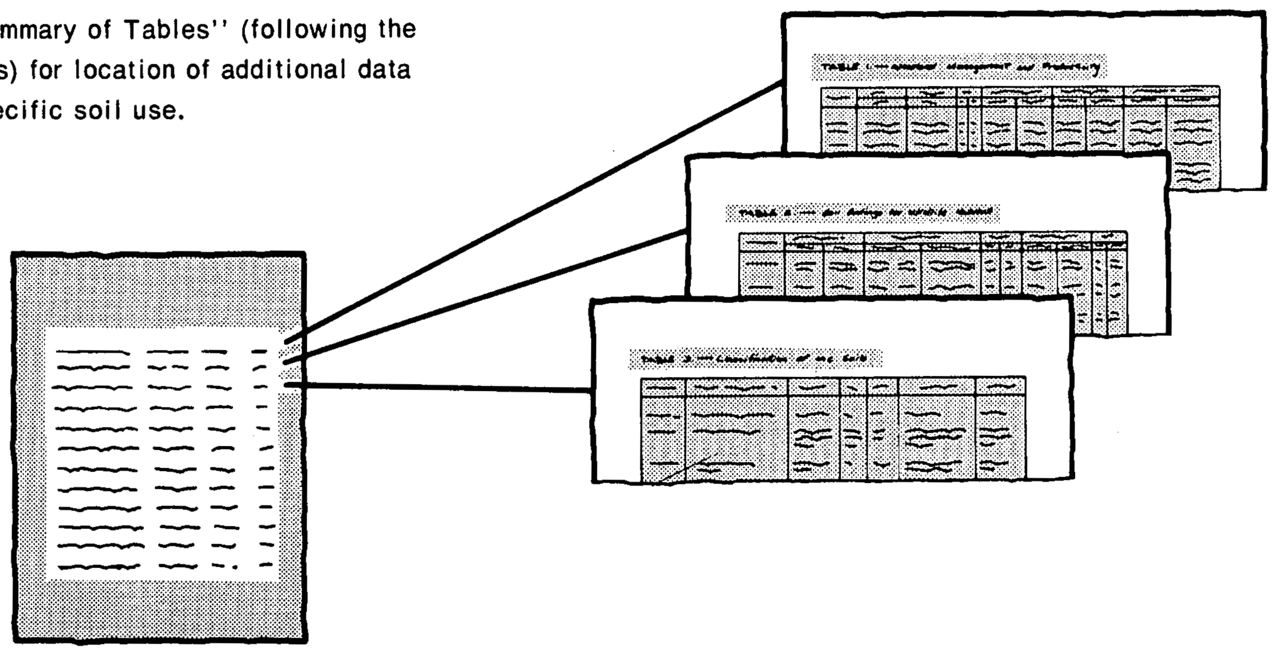
AsB
BaC
Ce
Fa
Ha
WaF

THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1984. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This soil survey was made cooperatively by the Soil Conservation Service, the Texas Agricultural Experiment Station, and the Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the Copano Bay Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Papalote fine sandy loam, 0 to 1 percent slopes, is in the Tight Sandy Loam range site. The cattle on this site are Santa Gertrudis.

Contents

Soil Series

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Summary of Tables

Foreword

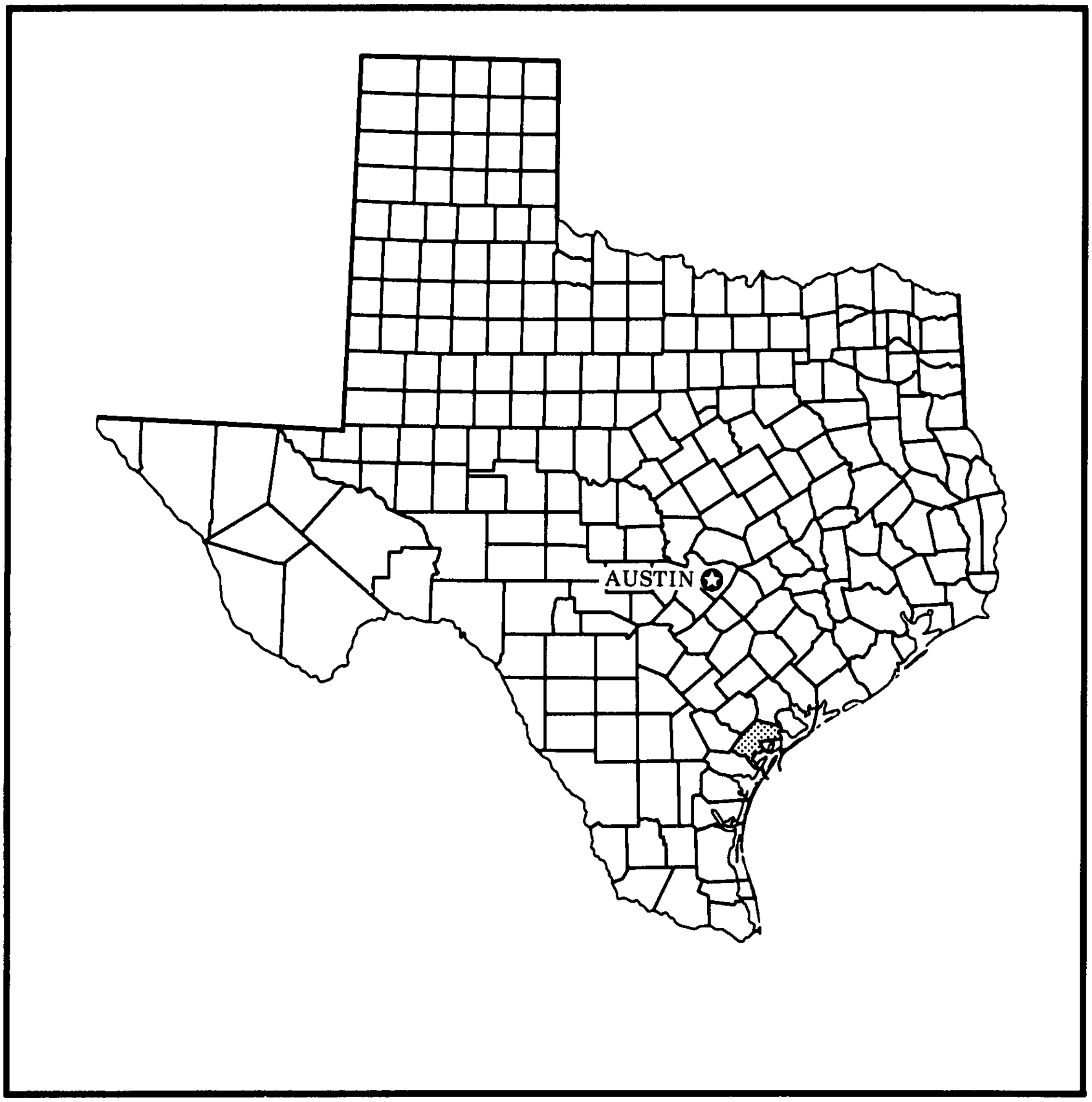
This soil survey contains information that can be used in land-planning programs in Refugio County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Harry W. Oneth
State Conservationist
Soil Conservation Service



Location of Refugio County in Texas.

Soil Survey of
Refugio County, Texas

By William J. Guckian, Soil Conservation Service

Fieldwork by William J. Guckian, Ramiro Molina and James A. Divin,
Soil Conservation Service

United States Department of Agriculture,
Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station and the
Texas State Soil and Water Conservation Board

REFUGIO COUNTY is in south Texas on the Texas Gulf Coast, mainly in the Gulf Coast Prairies Land Resource Area. A small area along the extreme eastern boundary is in the Gulf Coast Saline Prairies Land Resource Area *(17)*.

The county is roughly rectangular. Its axis is about 34 miles long northeast to southwest and about 24 miles wide from northwest to southeast. Refugio County has a total area of about 807 square miles, or 516,262 acres. It has a land area of 771 square miles, or 493,350 acres, and 36 square miles, or 22,912 acres, of water within its boundaries. The land surface is a level, almost featureless plain except for a small area along the western boundary that is gently rolling. The drainage is easterly or southeasterly. The important major streams are the San Antonio, Guadalupe, Mission, and Aransas Rivers. The Artesian, Salt, Copano, Melon, Devil's Run, and Chocolate Swale Creeks are the important minor streams.

In 1979 about 78 percent of the county was used for grazing livestock, 77 percent was used as range, and 1 percent was used as improved pasture. About 19 percent of the county was cropland, and 3 percent was in urban and other land uses *(14)*. Cow-calf operations are the main livestock enterprises, while grain sorghum, cotton, and corn are the main cultivated crops.

The population was estimated to be 9,289 in 1980. Refugio is the county seat and is located in the south central part of the county. It has a population of about 5,000 and is an agribusiness and petroleum producing center. Other communities in the county include Woodsboro, Tivoli, Austwell, Bayside, and Bonnie View.

The soils in the county formed under grasses and are dominantly dark color, clayey and loamy soils. Drainage is a serious problem in most of the county.

General Nature of the County

This section provides information of general interest about Refugio County. It discusses briefly the climate, history, and natural resources and industry.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The climate of Refugio County is subtropical with hot, humid summers and dry, mild winters. Prolonged cold spells or snowfalls are rare. Rains are generally heaviest late in spring and early in fall. Rain in the summer and early fall is often associated with tropical storms. The average annual rainfall is about 38 inches, and the average annual temperature is about 70 degrees. The growing season averages about 304 days.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Refugio in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 57 degrees F, and the average daily minimum temperature is 45

degrees. The lowest temperature on record, which occurred at Refugio on January 12, 1962, is 8 degrees. In summer the average temperature is 83 degrees, and the average daily maximum temperature is 93 degrees. The highest recorded temperature, which occurred at Refugio on August 13, 1962, is 106 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 38.77 inches. Of this, 25 inches, or 60 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 17 inches. The heaviest 1-day rainfall during the period of record was 13.38 inches at Refugio on October 16, 1960. Thunderstorms occur on about 30 days each year, and most occur in summer.

Snowfall is rare. In 99 percent of the winters, there is no measurable snowfall. In 1 percent, the snowfall, usually of short duration, is less than 1 inch. The heaviest 1-day snowfall on record was less than 1 inch.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 90 percent. The sun shines 75 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 14 miles per hour, in spring.

History

Refugio County is one of the original counties of the Republic of Texas. It was created in 1836 and organized in 1837. The county was named for Mission Nuestra Senora del Refugio which was founded in 1793. The villa of Refugio was established in 1831. The city of Refugio was founded in 1834 and became the county seat in 1837. The county government later moved to St. Marys then to Rockport until Aransas County was organized in 1871. At that time, the county government moved back to Refugio permanently. The original area was reduced by the formation of Goliad County in 1841, Calhoun County in 1846, and Aransas County in 1871. Awards of land to San Patricio and Victoria Counties in 1846, Bee County in 1857, and Nueces County in 1858 reduced the county to its present size.

The county had a slow growth rate until oil exploration began in 1918 and significant oil and gas production began in 1926. Since the oil boom, the county has settled back into a slow growth rate.

Natural Resources and Industry

The soil of the county is the most important natural resource. The soils, in general, are excellent for grass production and field crops. Farming and ranching are the major agricultural enterprises in Refugio County. Beef cattle is the most important product of rangeland. Grain sorghum, cotton, and corn are the most important field crops grown.

Oil and gas is produced throughout the county. A few large tank farms and small gas and petroleum refining plants are near Refugio.

Tourism is becoming more important. Access to the Aransas National Wildlife Refuge is through Refugio County. A few fishing and hunting camps are also in the county.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture,

size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Victoria-Edroy-Orelia

Deep, moderately alkaline to slightly acid, clayey and loamy soils formed in clayey and loamy marine sediments on uplands

These soils are nearly level and are on broad coastal plains (fig. 1). Slopes range from 0 to 1 percent. This map unit makes up about 53 percent of the county. It is about 73 percent Victoria soils, 10 percent Edroy soils, 8 percent Orelia soils, and 9 percent soils of minor extent. Victoria soils are in the highest position on the landscape, and the surface is plane to slightly convex. Edroy soils are in the lowest position, and the surface is concave to depressional. The surface of the Orelia soils is plane to slightly concave. Of minor extent are the Aransas, Copano, Faddin, Falfurrias, Monteola, Narta, Papalote, Sarita, Sinton, Victine, and Vidauri soils.

Victoria soils have a surface layer of very dark gray and black clay about 45 inches thick. The subsoil is light brownish gray clay to a depth of 72 inches. The underlying material is light gray clay to a depth of about 94 inches. The soils are moderately alkaline and calcareous throughout.

Edroy soils have a surface layer of dark gray clay about 28 inches thick. The subsoil extends to a depth of 47 inches. To a depth of 42 inches, it is light brownish gray clay grading to a light gray sandy clay. Below that, the subsoil is light gray sandy clay loam. The underlying material to a depth of 60 inches is very pale brown sandy clay loam. The soils are slightly acid or neutral in the surface layer and are mildly alkaline or moderately alkaline in the subsoil and underlying material.

Orelia soils have a surface layer of gray fine sandy loam about 6 inches thick. The subsoil is sandy clay loam to a depth of 37 inches. It is very dark gray in the upper part and gray in the lower part. The underlying material to a depth of 60 inches is light gray sandy clay loam. The soils are slightly acid or neutral in the upper part and are saline, moderately alkaline and calcareous in the lower part.

The soils of this map unit are used mainly as rangeland. In some areas, they are used as permanent pasture or cropland.

These soils are capable of producing medium yields of range forage. Crop and pasture yields are medium to high. Major crops are cotton, corn, and grain sorghum.

The soils of this map unit are poorly suited to urban uses. Most of the soils have high shrink-swell potential, slow or ponded surface drainage, and high corrosivity to uncoated steel. Buildings and streets crack and buckle if not properly constructed. The very slow permeability causes septic systems to fail during extended wet periods.

These soils are poorly suited to recreational uses. They are very sticky when wet, which affects foot and vehicle traffic. These soils provide habitat for some deer, turkey, quail, dove, rabbit, and javelina.

2. Papalote-Orelia

Deep, neutral or slightly acid, loamy and sandy soils formed in clayey and loamy sediments; on uplands

These soils are nearly level to gently sloping and are on broad coastal plains (fig. 2). Slopes range from 0 to 5 percent. This map unit makes up about 27 percent of the county. The Papalote soils are in the highest position on the landscape, and the surface is plane to slightly convex. The surface of the Orelia soils is plane to slightly concave. Of minor extent are the Aransas, Copano, Edroy, Faddin, Falfurrias, Inez, Monteola, Narta, Odem, Sarita, Sinton, Victine, Victoria, and Vidauri soils.

Papalote soils have a surface layer of grayish brown fine sandy loam or loamy fine sand about 11 inches thick. The subsoil extends to a depth of 52 inches. It is grayish brown clay to a depth of 18 inches, and to a depth of 43 inches, it is sandy clay that is light brownish

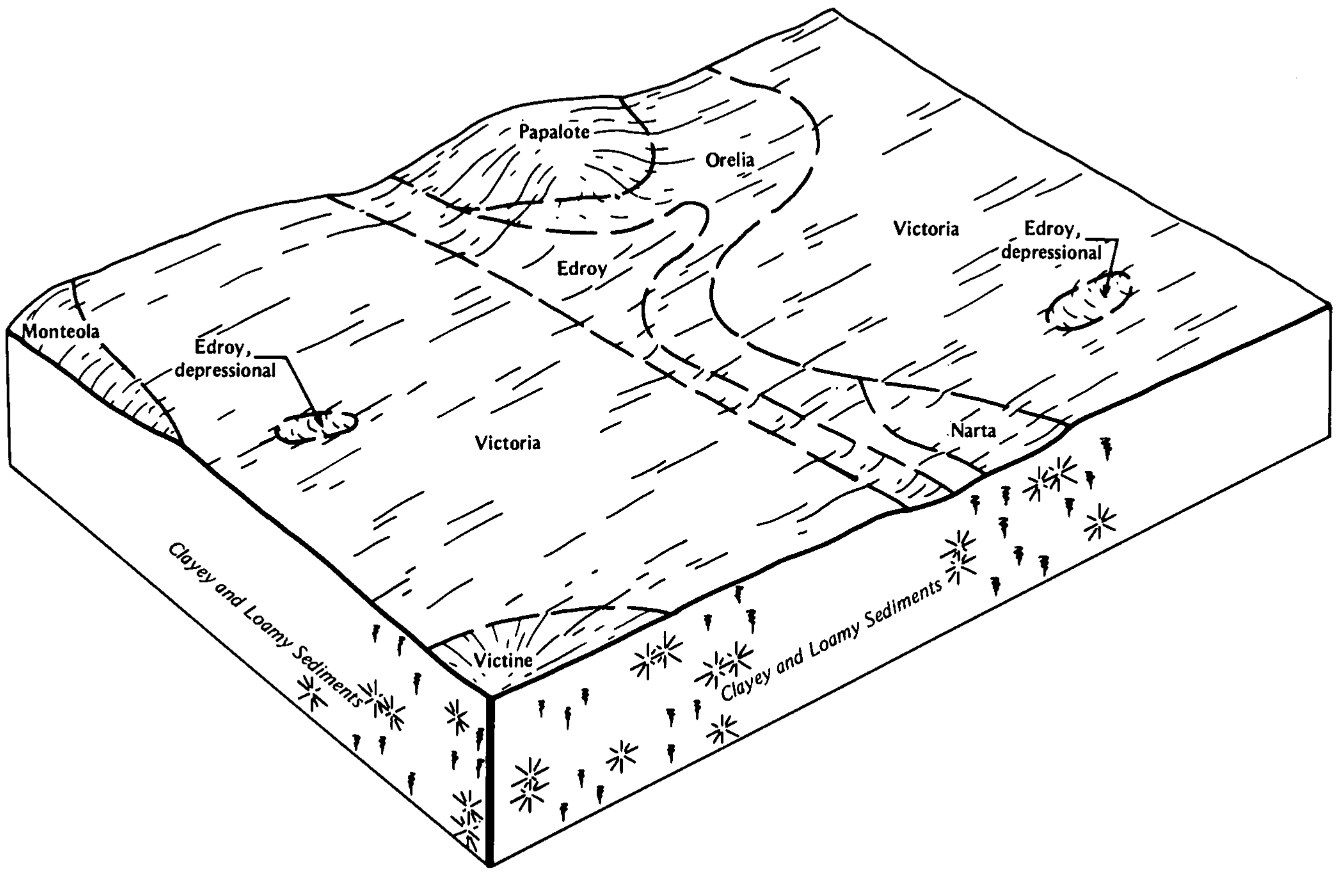


Figure 1.—Typical pattern of soils and underlying material in the Victoria-Edroy-Orelia map unit.

gray in the upper part and light gray in the lower part. Below that, the subsoil is very pale brown sandy clay loam. Mottles in shades of yellow, brown, and gray are throughout the subsoil. The underlying material is very pale brown sandy clay loam to a depth of 60 inches. The soils are slightly acid or neutral in the upper part and are mildly alkaline or moderately alkaline and calcareous in the lower part.

Orelia soils have a surface layer of gray fine sandy loam about 6 inches thick. The subsoil is sandy clay loam to a depth of 37 inches. It is very dark gray in the upper part and gray in the lower part. The underlying material to a depth of 60 inches is light gray sandy clay loam. The soils are slightly acid or neutral in the upper part and are saline, moderately alkaline and calcareous in the lower part.

The soils of this map unit are used mostly as rangeland. In some areas, they are used as cropland or for permanent pasture. These soils are capable of producing medium yields of range forage. Crop and pasture yields are generally medium. Major crops are grain sorghum, corn, and cotton.

These soils are poorly suited to urban uses. They have high corrosivity to uncoated steel, slow surface drainage, and moderate shrink-swell potential. The slow to very slow permeability causes problems with septic systems.

The soils of this map unit are poorly suited to recreational uses. Some of the soils stay wet for long periods following heavy rainfall. These soils provide habitat for deer, turkey, quail, dove, and javelina.

3. Faddin-Wyick-Vidauri

Deep and moderately deep, slightly acid, loamy soils formed in clayey and loamy sediments; on uplands

These soils are nearly level and are on broad coastal plains (fig. 3). Slopes range from 0 to 2 percent. This map unit makes up about 9 percent of the county. Faddin soils are in the highest position on the landscape, and the surface is slightly convex. Wyick soils are below the Faddin soils, and the surface is plane. Vidauri soils

are in the lowest position, and the surface is plane and slightly concave. Of minor extent are the Copano, Edroy, Falfurrias, Inez, Narta, Orelia, Papalote, Sarita, and Victoria soils.

Faddin soils have a surface layer of grayish brown fine sandy loam about 19 inches thick. The subsoil extends to a depth of at least 60 inches. It is grayish brown clay to a depth of 27 inches, light brownish gray sandy clay to a depth of 39 inches, light gray sandy clay to a depth of 52 inches, and light gray sandy clay loam below that. The subsoil has mottles in shades of red, brown, and yellow to a depth of 52 inches. The soils are slightly acid or neutral in the upper part and are mildly alkaline or moderately alkaline in the lower part.

Wyick soils have a surface layer of light brownish gray fine sandy loam about 10 inches thick. The subsoil extends to a depth of 38 inches. It is light brownish gray clay to a depth of 21 inches, light gray clay loam to a depth of 32 inches, and very pale brown sandy clay loam below that. The subsoil has mottles in shades of brown and gray to a depth of 32 inches. The underlying material to a depth of 60 inches is light gray sandy clay loam. The soils are medium acid to neutral in the upper part and mildly alkaline or moderately alkaline in the lower part.

Vidauri soils have a surface layer of light brownish gray fine sandy loam about 6 inches thick. The subsoil extends to a depth of at least 66 inches. It is grayish brown and light brownish gray clay to a depth of 21 inches, light brownish gray sandy clay to a depth of 31 inches, and very pale brown sandy clay loam below that. The subsoil has mottles in shades of yellow and brown throughout. The soils are slightly acid or neutral in the upper part and are mildly alkaline or moderately alkaline in the lower part.

The soils of this map unit are used mostly as rangeland. In some areas, they are used as cropland or permanent pasture. These soils are capable of producing medium to high yields of range forage, and crop and pasture yields are generally medium to high. The major crop is grain sorghum.

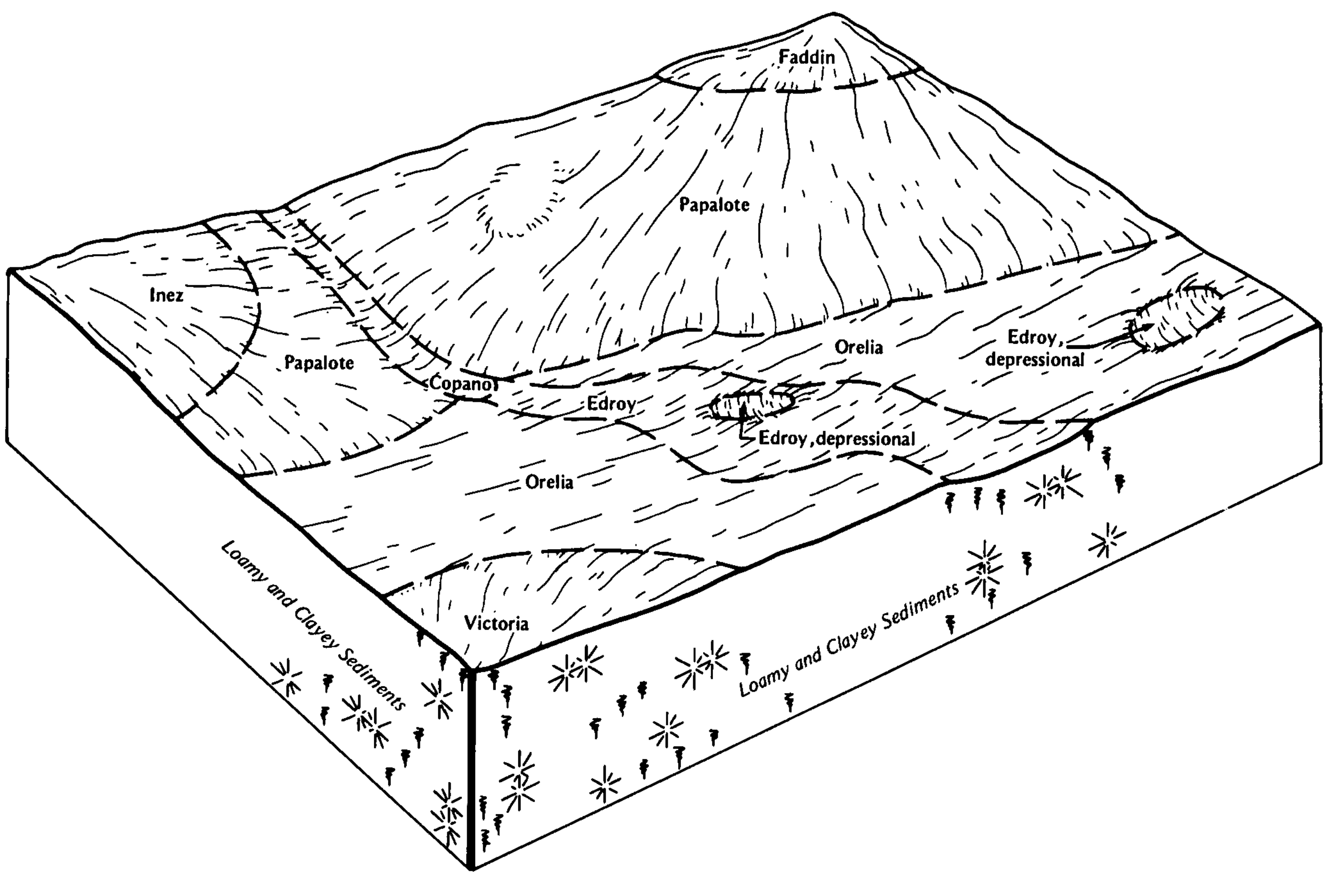


Figure 2.—Typical pattern of soils and underlying material in the Papalote-Orelia map unit.

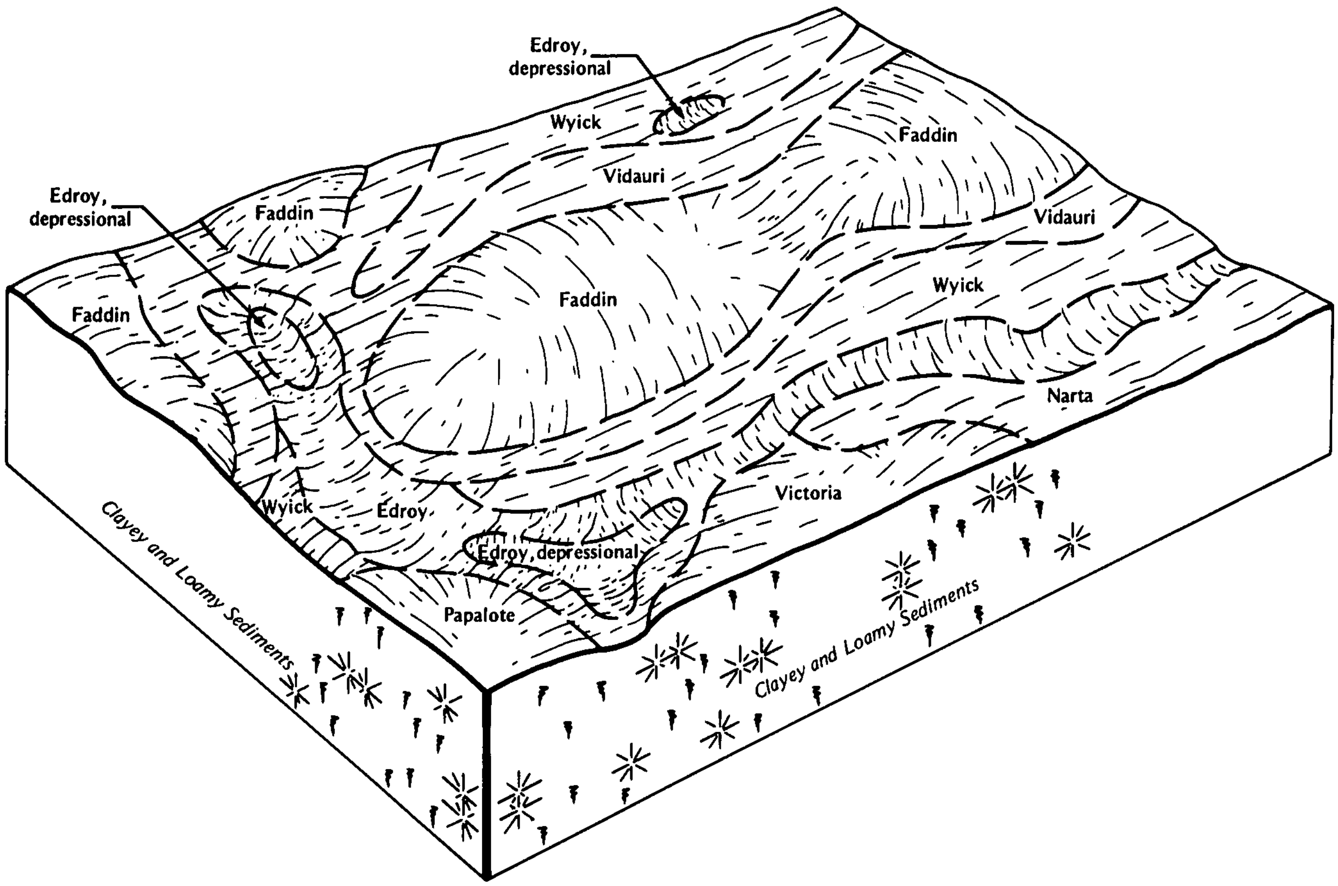


Figure 3.—Typical pattern of soils and underlying material in the Faddin-Wyick-Vidauri map unit.

These soils are poorly suited to urban uses. They have high shrink-swell potential, slow surface drainage, and high corrosivity to uncoated steel. The very slow permeability causes problems with septic systems.

The soils of this map unit are poorly suited to recreational uses. Most of the soils stay wet for long periods following heavy rainfall. The soils provide fair habitat for deer, turkey, quail, dove, ducks, geese, rabbit, and javelina.

4. Aransas-Sinton-Odem

Deep, moderately alkaline or mildly alkaline, clayey and loamy soils formed in recent alluvium; on flood plains and low stream terraces

These soils are nearly level to gently undulating and are along streams and on coastal deltas (fig. 4). Slopes range from 0 to 2 percent. This map unit makes up about 5 percent of the county. It is about 49 percent Aransas soils, 31 percent Sinton soils, 11 percent Odem soils, and 9 percent soils of minor extent. Aransas soils are in the lowest position on the landscape, and the surface is plane to slightly concave. Sinton soils are slightly higher, and the surface is plane to slightly convex. Odem soils are in the highest position, and the surface is plane to convex. Of minor extent are the Falfurrias and Sarita soils.

Aransas soils have a surface layer of very dark gray clay about 49 inches thick. The underlying material to a depth of 60 inches is gray clay. The soils are moderately alkaline and calcareous, and in coastal areas they are saline throughout.

Sinton soils have a surface layer of clay loam about 35 inches thick that is dark gray in the upper part and dark grayish brown in the lower part. The underlying material to a depth of 60 inches is light brownish gray sandy clay loam. To a depth of 70 inches, it is very pale brown fine sandy loam. The soils are moderately alkaline and calcareous throughout.

Odem soils have a surface layer of fine sandy loam about 36 inches thick that is dark gray in the upper part and dark grayish brown in the lower part. The underlying material to a depth of 68 inches is very pale brown fine sandy loam. The soils are slightly acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. Some areas of these soils are calcareous.

The soils of this map unit are used mostly as rangeland. In some areas, they are used as cropland or permanent pasture. These soils are capable of producing high yields of range forage. Crop and pasture yields are generally low to medium because of flooding. Yields are high where excess water is controlled. The major crops are cotton, grain sorghum, and corn.

These soils are not suited to urban uses and are poorly suited to recreational uses because of flooding. They are poorly suited to use as habitat for wildlife.

5. Aransas-Victine-Narta

Deep, saline, moderately alkaline, clayey and loamy soils formed in recent alluvium and marine sediment; on coastal flood plains and low terraces

These soils are nearly level and are on coastal flood plains and low terraces (fig. 5). Slopes range from 0 to 1 percent. This map unit makes up about 5 percent of the county. It is about 49 percent Aransas soils, 27 percent Victine soils, 12 percent Narta soils, and 12 percent soils of minor extent. Aransas soils are in the lowest position on the landscape, and the surface is plane to slightly concave. Victine soils are in the highest position, and the surface is plane to slightly convex. Narta soils are slightly lower than the Victine soils, and the surface is plane to slightly concave. Of minor extent are Barrada and Odem soils and Aransas soils that are not saline.

Aransas soils have a surface layer of very dark gray clay about 40 inches thick. The underlying material to a

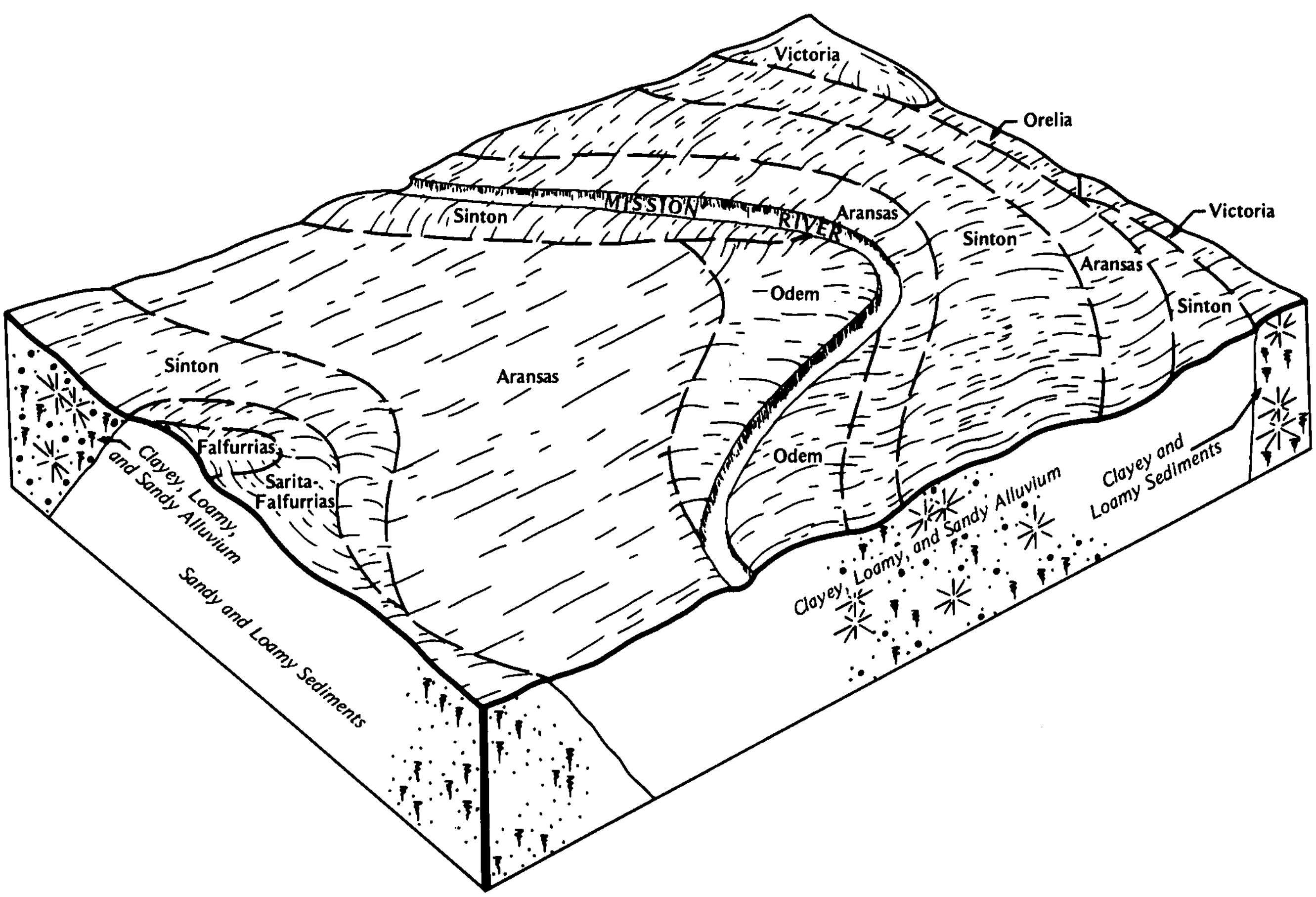


Figure 4.—Typical pattern of soils and underlying material of the Aransas-Sinton-Odem map unit.

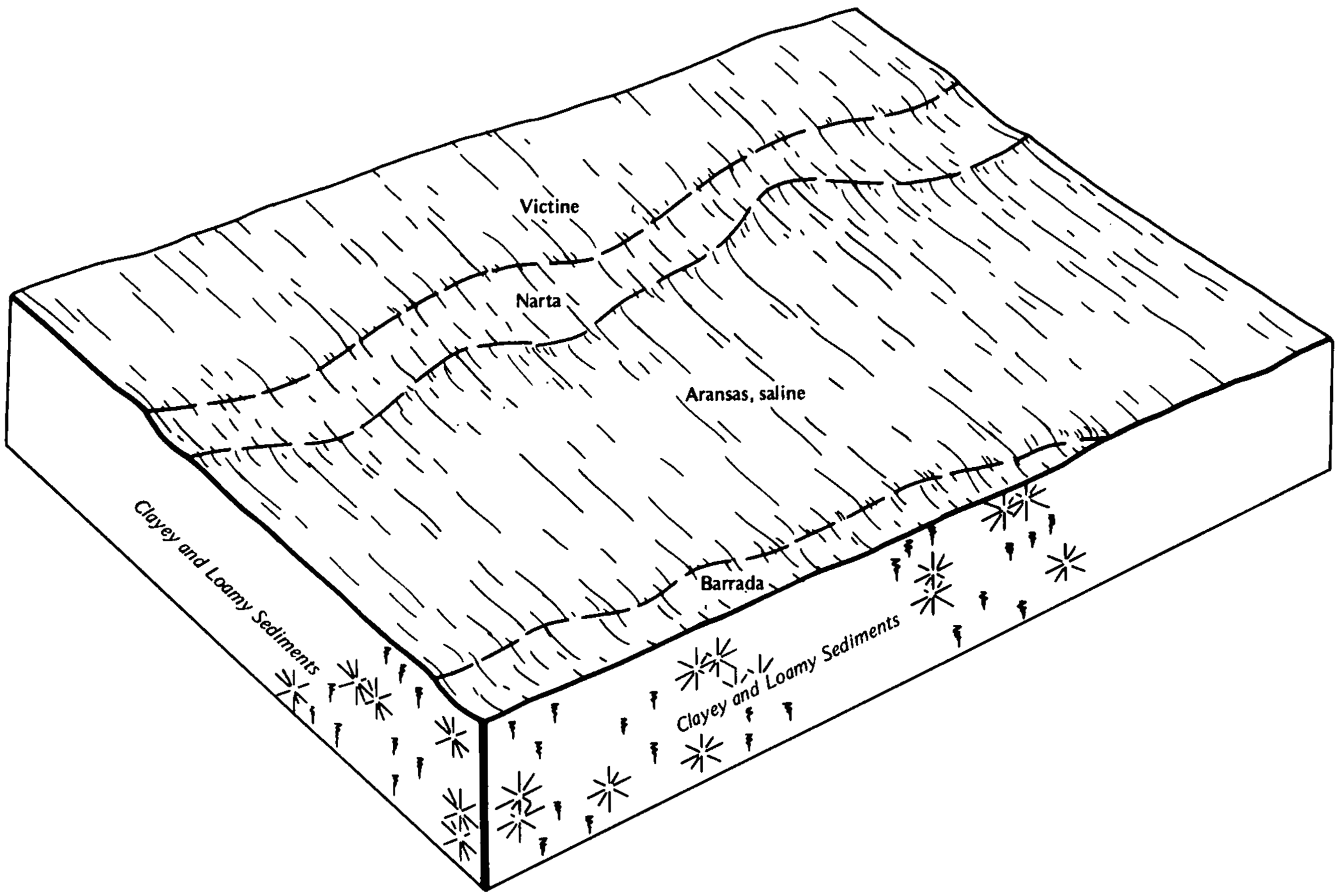


Figure 5.—Typical pattern of soils and underlying material in the Aransas-Victine-Narta map unit.

depth of about 72 inches is gray clay. The soils are moderately alkaline, calcareous, and saline throughout.

Victine soils have a surface layer of very dark gray clay about 44 inches thick. The subsoil is gray clay to a depth of 64 inches. The underlying material to a depth of about 72 inches is light gray clay. The soils are moderately alkaline or strongly alkaline, calcareous, and saline throughout.

Narta soils have a surface layer of grayish brown fine sandy loam about 7 inches thick. The subsoil is clay to a depth of 54 inches. It is dark gray to a depth of 20 inches and gray below that. The underlying material to a depth of about 60 inches is light gray clay loam. The soils are moderately alkaline and saline throughout.

The soils of this map unit are used almost exclusively as rangeland. In a few areas, Victine soils are used as cropland or for permanent pasture grasses. Aransas and Narta soils are not suitable for use as cropland.

These soils are capable of producing medium yields of range forage, but crop and pasture yields are low on Victine soils. Major crops are cotton and grain sorghum.

The soils of this map unit are poorly suited to urban uses. In some areas, these soils are subject to frequent flooding by both fresh and salt water, and in nearly all areas, they are subject to occasional inundation by salt water from high storm tides.

These soils are poorly suited to use for recreation areas and as habitat for wildlife because of salinity, wetness, and flooding.

6. Dietrich-Galveston-Mustang

Deep, neutral or mildly alkaline, sandy soils formed in loamy and sandy marine sediments; on coastal flood plains and low terraces

These soils are gently undulating to nearly level and are on coastal flood plains and low terraces (fig. 6). Slopes range from 0 to 3 percent. This map unit makes up about 1 percent of the county. It is about 29 percent

Dietrich soils, 16 percent Galveston soils, 10 percent Mustang soils, and 45 percent soils of minor extent. Dietrich soils are between the Galveston and Mustang soils, and the surface is plane. Galveston soils are in the highest position on the landscape, and the surface is gently undulating to hummocky and convex. Mustang soils are in the lowest position, and the surface is plane to slightly concave. Of minor extent are the Falfurrias, Narta, Orelia, Victine, and Victoria soils.

Dietrich soils have a surface layer of pale brown loamy fine sand about 7 inches thick. The subsurface layer is light gray loamy fine sand to a depth of 9 inches. The subsoil to a depth of 44 inches is sandy clay loam. It is dark grayish brown in the upper part, light brownish gray in the middle part, and light gray in the lower part. The subsoil has mottles in shades of red, yellow, brown and gray throughout. The underlying material to a depth of 60 inches is light gray sandy clay loam that has distinct yellow and brown mottles. The soils are slightly acid or neutral in the upper part and mildly alkaline or moderately alkaline and saline in the lower part.

Galveston soils have a surface layer of gray fine sand about 4 inches thick. The underlying material to a depth of 44 inches is light gray fine sand. To a depth of 72 inches, it is white fine sand that has yellow mottles. The soils are slightly acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. Some areas are saline and calcareous. A permanent high water table fluctuates between depths of 40 and 72 inches.

Mustang soils have a surface layer of light brownish gray fine sand about 6 inches thick. The underlying material to a depth of 80 inches is fine sand. It is light gray in the upper part, white in the lower part, and has brownish yellow mottles throughout. The soils are neutral to moderately alkaline. Some areas are saline and calcareous. A fluctuating permanent high water table occurs at a depth of less than 40 inches.

The soils of this map unit are used mostly as rangeland. In some areas, they are used for permanent pasture.

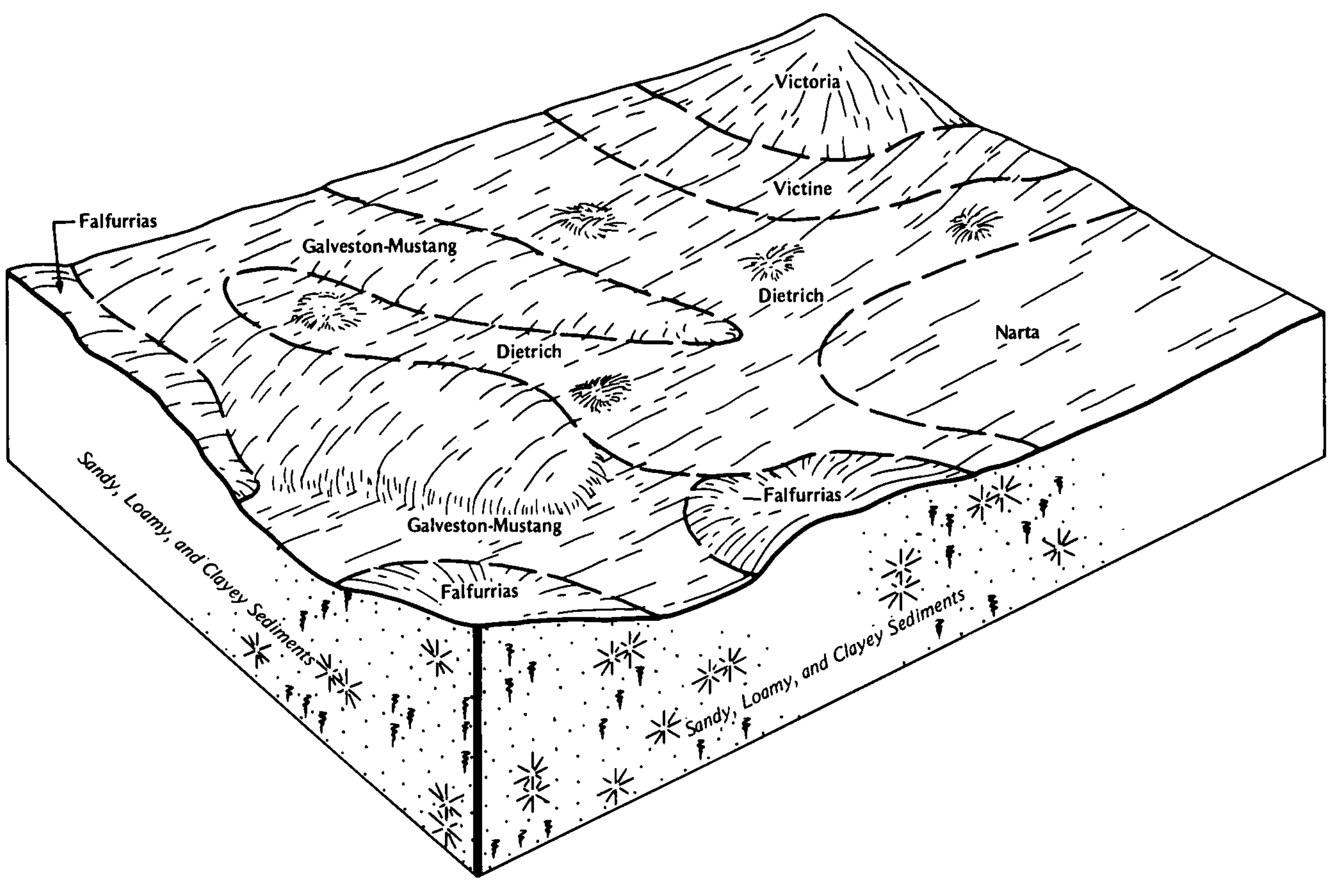


Figure 6.—Typical pattern of soils and underlying material in the Dietrich-Galveston-Mustang map unit.

These soils are not suited to use as cropland, and they produce low yields of range forage. Pasture yields are also generally low.

These soils are not suited to urban uses because of flooding and the high water table. They are poorly suited to recreational uses because of flooding, wetness, and the sandy texture. These soils are fairly well suited to use as habitat for wildlife.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Papalote loamy fine sand, 0 to 3 percent slopes, is one of several phases in the Papalote series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Sarita-Falfurrias fine sands, 0 to 5 percent slopes is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Oil-waste land is an example. The areas of Oil-waste land are identified by a special symbol on the soil maps. There is no map unit of Oil-waste land in this survey, because the areas are too small to be shown on the soil maps except by special symbol. Oil-waste land consists of areas where liquid oily wastes, principally saltwater and oil, have accumulated. The land is barren, although some of it can be reclaimed at high cost.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Ac—Aransas clay, occasionally flooded. This soil is deep, nearly level, and poorly drained. It is on flood plains. The surface is nearly level to slightly concave. Slopes are 0 to 1 percent, averaging about 0.5 percent. Individual areas are long and narrow to irregularly shaped and range from about 40 to 200 acres.

Typically, the surface layer is moderately alkaline clay about 50 inches thick. It is very dark gray to a depth of 36 inches and dark gray below that. The underlying material to a depth of 60 inches is moderately alkaline, light gray clay.

This soil has very slow surface runoff or is ponded. Permeability is very slow, and the available water capacity is high. When the soil is dry, cracks up to 1 inch wide extend from the surface to a depth of 30 to 40 inches. Water enters this soil rapidly when it is dry and cracked, but very slowly when it is wet and the cracks are sealed. The root zone is deep, but clay content tends to impede the movement of air, water, and roots. This soil is occasionally flooded following heavy rainfall, mostly during the spring and fall. Flooding occurs about 3 times in 10 years, and the soil is inundated from a few hours to a few days. Water erosion is a slight hazard.

Included in mapping are small areas of Edroy, Odem, and Sinton soils. Also included are small areas of soils that are frequently flooded, soils that are saline, soils that have a clay loam surface layer, have slopes of more than 1 percent, or have up to 6 inches of loamy or sandy

overwash from adjacent upland soils. The included soils make up less than 20 percent of the map unit.

This Aransas soil is used mainly as rangeland, habitat for wildlife, or improved pasture. In a few areas, it is used as cropland.

The climax plant community is a savannah of mixed grasses, shrubs, woody plants, and an occasional motte of trees. Forage production is high. Because of the variety of plants, many deer, turkey, quail, dove, javelina, song birds, and predatory animals are attracted to the areas of this soil. Proper management practices, such as controlled grazing, proper stocking, and brush management, help in maintaining high productivity.

Occasional flooding, wetness, and poor soil tilth reduce yields on improved pasture and cropland. Improved varieties of bermudagrass, bluestems, kleingrass, and bahiagrass are the main pasture grasses, and grain sorghum, cotton, and corn are the main cultivated crops. Fertilization, weed control, controlled grazing, proper stocking, and brush management improve and help maintain pasture productivity. Cropping systems need to include water management. In some areas, simple drainage practices can remove excess water, but in others, a drainage system needs to be installed. Diversion terraces are desirable in some areas to control runoff from adjoining uplands. Fertilization, conservation tillage, cover crops, and residue management improve and help maintain soil tilth, fertility, and productivity.

This soil is severely restricted for urban and recreational uses by occasional flooding, wetness, high shrink-swell potential, very slow permeability, the clayey texture, and the corrosiveness of uncoated steel.

This Aransas soil is in capability subclass IIIw and in the Clayey Bottomland range site.

Af—Aransas clay, frequently flooded. This soil is deep, nearly level, and poorly drained. It is on flood plains and in basins, sloughs, and abandoned stream channels. The surface is nearly level to slightly concave. Slopes are less than 1 percent, averaging about 0.3 percent. Individual areas are mostly long and narrow and range from about 10 to 100 acres.

Typically, the surface layer is moderately alkaline, very dark gray clay about 49 inches thick. The underlying material to a depth of 60 inches is moderately alkaline, gray clay.

This soil has very slow surface runoff or is ponded. Permeability is very slow, and the available water capacity is high. The root zone is deep, but clay content tends to impede the movement of air, water, and roots. This soil is frequently flooded following heavy rainfall, mostly during the spring and fall. Flooding occurs about 6 times in 10 years, and the soil is inundated from several days to several weeks or more. Water erosion is a slight hazard.

Included in mapping are small areas of Edroy, Odem, and Sinton soils. Also included are small areas of soils that are occasionally flooded, and soils that are saline. Soils that have a clay loam surface layer, have slopes of more than 1 percent, or have up to 6 inches of loamy or sandy overwash are also included. The included soils make up less than 20 percent of the map unit.

This Aransas soil is used almost exclusively as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture.

The climax plant community is a savannah of mixed grasses, shrubs, woody plants, and an occasional motte of trees. Forage production is high, and a wide variety of plants are present; however, few wildlife species use these areas because of frequent flooding and wetness. Proper management practices, such as controlled grazing, proper stocking, and brush management help in maintaining high productivity.

Frequent flooding and wetness reduce yields on improved pasture. Improved varieties of bermudagrass, bluestems, kleingrass, and bahiagrass are the main pasture grasses. Fertilization, weed control, controlled grazing, and brush management improve and help maintain pasture productivity.

This soil is severely restricted for cropland use or for urban and recreational uses because of frequent flooding, wetness, poor soil tilth, high shrink-swell potential, very slow permeability, the clayey texture, and the corrosiveness of uncoated steel.

This Aransas soil is in capability subclass Vw and in the Clayey Bottomland range site.

As—Aransas clay, saline, frequently flooded. This soil is deep, nearly level, and poorly drained. It is on flood plains of streams, inland bays, and coastal areas. The surface is nearly level to slightly concave. Slopes are less than 1 percent, averaging about 0.5 percent. Individual areas are mostly long and narrow and range from about 10 acres to several hundred acres.

Typically, the surface layer is moderately alkaline, moderately saline, very dark gray clay about 40 inches thick. It has a few threads and masses of calcium carbonate and salt crystals. The underlying material to a depth of 72 inches is moderately alkaline, strongly saline, gray clay that has a few calcium carbonate and black concretions and threads and pockets of salt crystals.

This soil has very slow surface runoff or is ponded. Permeability is very slow. The available water capacity is low because of salinity. The root zone is deep, but clay content tends to impede movement of air, water, and roots. Salt content restricts vegetation to salt-tolerant species. This soil is occasionally flooded by salt water and frequently flooded by fresh water. Flooding by salt water occurs about 3 times in 10 years from high tides that accompany tropical storms and hurricanes, mostly in the summer and fall. Flooding by fresh water occurs

about 6 times in 10 years following heavy rainfall, mostly during the spring and fall. Water erosion is a slight hazard.

Included in mapping are small areas of Barrada, Edroy, Narta, Odem, Sinton, and Victine soils. Small areas of soils that have a clay loam surface layer, have slopes of more than 1 percent, or have up to 6 inches of loamy or sandy overwash are in areas of salt water inundation along the coast. Small areas of soils that are occasionally flooded or that are not saline are in inland areas above salt water inundation. Also included are small areas that have a clay loam surface layer, have slopes of more than 1 percent, or have up to 6 inches of loamy or sandy overwash. The included soils make up less than 20 percent of the map unit.

This Aransas soil is used exclusively as rangeland and habitat for wildlife.

The climax plant community is an open grassland dominated by salt- and water-tolerant grasses, sedges, and reeds. Forage production is high, but because of frequent flooding, salinity, and wetness, vegetation is restricted to a narrow range of salt- and water-tolerant plants. As a result, few wildlife species are attracted to these areas. Waterfowl and shorebirds are in coastal areas, and a few deer, turkey, javelina, and coyote are in inland areas. Proper management practices, such as controlled grazing and proper stocking, help maintain high productivity of salt-tolerant vegetation.

This soil is severely restricted for use as improved pasture, cropland, and for urban and recreational uses because of frequent flooding, salinity, wetness, soil tilth, high shrink-swell potential, very slow permeability, clayey texture, and corrosiveness of uncoated steel.

This Aransas soil is in capability subclass VIw and in the Salty Bottomland range site.

Ba—Barrada clay. This soil is deep, nearly level, and very poorly drained. It is on coastal tidelands and lowlands. The surface is slightly concave to plane. Elevation ranges from sea level to about 3 feet above sea level. Slopes are less than 0.5 percent. Individual areas are long and narrow along the coastline and broad and irregular around inland bays and on stream deltas (fig. 7). They range from about 10 to 200 acres.

Typically, the soil is strongly alkaline, strongly saline clay to a depth of 54 inches. It is light gray to a depth of 4 inches, and below that it is light brownish gray to light gray with a few mottles in shades of brown and yellow.

This soil is ponded or has very slow surface runoff. Permeability is very slow. The available water capacity is very low because of salinity. A permanent high water table and the clay content impede movement of air and roots. Salt content is almost always at the toxic level and excludes all vegetation. In some areas, this soil is covered by daily high tides, and all of this soil is frequently flooded by abnormally high tides. This soil is seldom dry below a depth of about 8 inches and is saturated to the surface for periods of 4 to 6 months annually. A permanent high water table fluctuates somewhat with the tides, but is mainly at a depth of less than 36 inches. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Narta, and Victine soils. Small areas of soils that have slopes of more than 1 percent and soils that have a silty clay, loamy sand, or fine sandy loam surface layer are also included. The included soils make up less than 15 percent of the map unit.

This Barrada soil is used exclusively as habitat for wildlife. Numerous species of ducks, geese, herons, gulls, egrets, shorebirds, wading birds, and cranes are in these areas.

Use of this soil for improved pasture, crops, urban development, or recreational areas is restricted because of flooding by salt water, wetness, the high water table, salinity, corrosiveness of uncoated steel and concrete, and the clayey texture.

This Barrada soil is in capability subclass VIIIs and is not assigned a range site.

Co—Copano fine sandy loam. This soil is deep, nearly level, and poorly drained. It is in and around poorly defined drainageways on uplands. The surface is plane to slightly concave. Slopes range from 0 to 2 percent but are generally about 0.5 percent. Areas of this soil are long and narrow to irregularly shaped and range from 10 to about 200 acres.

Typically, the surface layer is neutral, grayish brown fine sandy loam 12 inches thick. The subsurface layer is neutral, light gray fine sandy loam to a depth of 14 inches. The subsoil extends to a depth of 56 inches. To a depth of 23 inches, it is neutral, gray clay that has yellowish brown and light gray mottles. Cracking is also evident in the form of very dark gray vertical streaks. To a depth of 42 inches, the subsoil is mildly alkaline, light gray sandy clay that has yellowish brown and a few gray mottles. It has a few dark grayish brown vertical streaks and a few black concretions. To a depth of 56 inches, it is moderately alkaline, very pale brown sandy clay loam that has brownish yellow mottles and black concretions. The underlying material to a depth of 72 inches is calcareous, moderately alkaline, white sandy clay loam. It has a few black concretions and about 5 percent, by volume, calcium carbonate concretions and masses.

This soil is ponded or has very slow surface runoff. Permeability is very slow, and the available water capacity is high. The root zone is deep, but clay content impedes movement of air, water, and roots. Water is ponded on the surface for periods of several days to several weeks following heavy rainfall. This soil is saturated to the surface for long periods during spring, fall, and winter of most years. Water erosion is a slight hazard.

Included in mapping are small areas of Edroy, Faddin, Inez, Orelia, Papalote, and Victoria soils. Also included

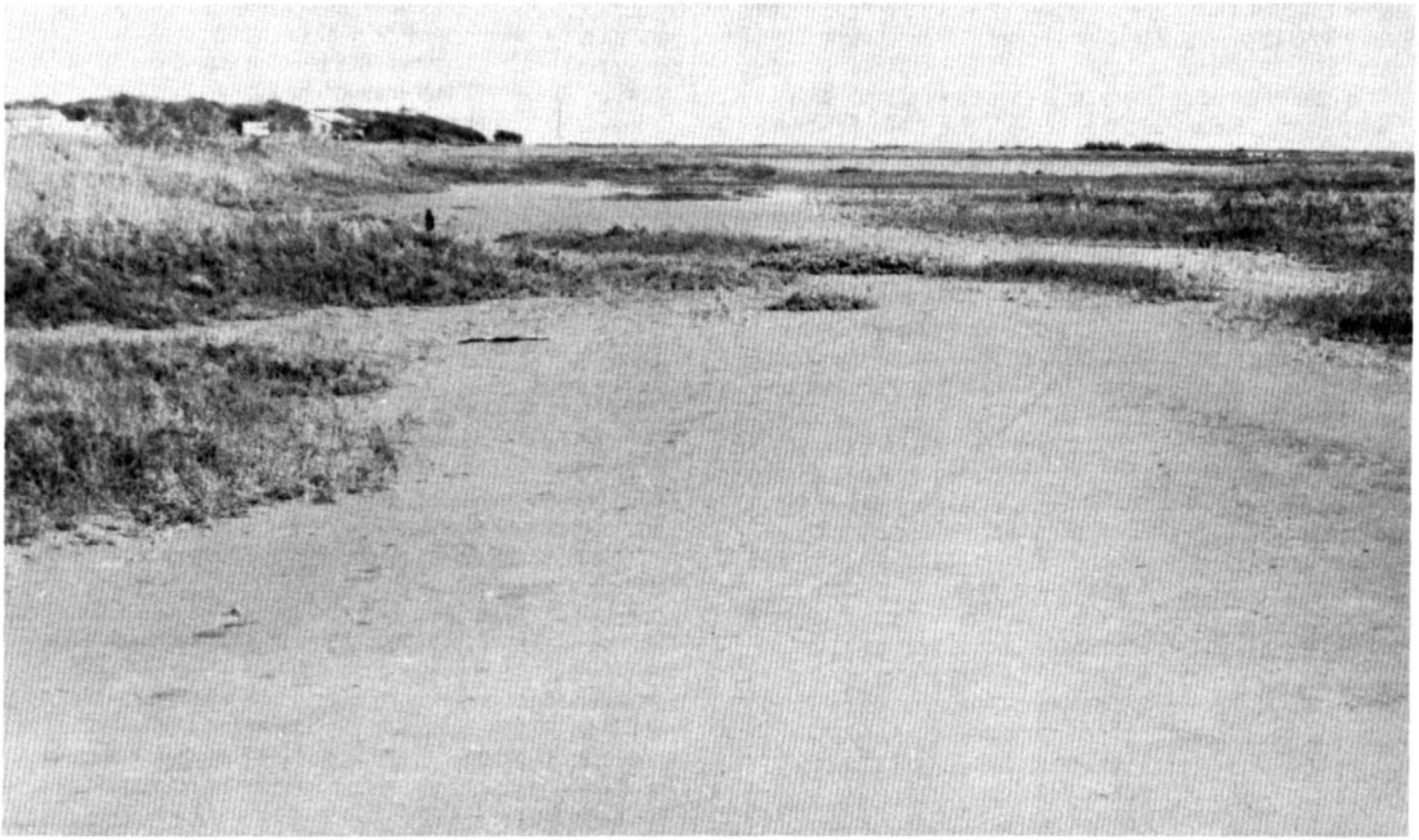


Figure 7.—Barrada clay is in areas affected by high tides. This soil is strongly saline throughout and is barren of vegetation. The vegetation in the background is on Aransas, Narta, and Victine soils.

are small areas of soils that have slopes of more than 2 percent and soils that have a thinner surface layer. The included soils make up less than 15 percent of the map unit.

This Copano soil is used mainly as rangeland and habitat for wildlife. In a few small areas, it is used as cropland or improved pasture.

The climax plant community is a savannah with about 30 percent tree canopy and an understory of mid and tall grasses. Forage production is only fair because of wetness and ponding of water. Some areas are dominated by brush and other woody plants because of overgrazing. Ponding of water attracts numerous ducks, geese, and other wetland wildlife. A few deer, turkey, javelina, and predators are in areas of this soil. Proper management, such as controlled grazing and brush management, can improve and help maintain productivity.

Wetness and ponding of water reduce yields on cropland and improved pasture. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestems, and kleingrass are the main pasture grasses. Cropping systems that include water management, fertilization, cover crops, conservation tillage, and residue management improve and help maintain fertility and productivity. In some areas, simple drainage practices remove excess water, but in other areas, a drainage system needs to be installed. Diversion terraces are needed in some areas of this soil to control runoff from surrounding higher areas. Fertilization, weed control, and controlled grazing improve and help maintain pasture productivity.

This soil is severely restricted for urban and recreational uses. Ponding, wetness, and very slow permeability affect septic tank systems. High shrink-swell potential and low strength are limitations for building foundations and for streets and roads. High corrosiveness of uncoated steel affects public utility installation. Recreation facilities are affected by wetness.

This Copano soil is in capability subclass IIIw and in the Sandy Loam range site.

Dt—Dietrich loamy fine sand. This soil is deep, nearly level, and somewhat poorly drained. It is on low coastal plains in a narrow band between the more clayey soils on uplands and the sandy soils on the coastline. The surface is plane to hummocky and slightly convex. Elevation above sea level ranges from about 2 to 10 feet. Slopes are 0 to 1 percent, averaging about 0.5 percent. Individual areas are long and irregularly shaped and range from 20 to 125 acres.

Typically, the surface layer is neutral, pale brown loamy fine sand about 7 inches thick. The subsurface layer is light gray loamy fine sand to a depth of 9 inches. The subsoil is mildly alkaline or moderately alkaline, very slightly saline or slightly saline, sandy clay loam to a depth of 44 inches. The upper part is dark grayish brown with common distinct red, yellow, brown, and gray mottles. The middle part is light brownish gray with common distinct yellow, brown, and gray mottles. The lower part is light gray with a few faint yellow and brown mottles and a few black concretions. The underlying material to a depth of 60 inches is moderately alkaline, slightly saline, light gray sandy clay loam that has common distinct yellow and brown mottles and a few calcium carbonate and black concretions.

This soil has slow to very slow surface runoff. Permeability is slow, and the available water capacity is moderate. The root zone is deep, but salinity and clay content impede movement of air, water, and roots. This soil is saturated to the surface for several days to several weeks following heavy rainfall. A perched high water table is between depths of 10 and 36 inches during fall, winter, and spring of most years. Soil blowing is a severe hazard, and water erosion is a slight hazard.

Included in mapping are small areas of Falfurrias, Galveston, Mustang, Narta, Papalote, and Sarita soils. Also included are small areas of soils that have slopes of more than 1 percent and soils that have a fine sandy loam surface layer. The included soils make up less than 15 percent of the map unit.

This Dietrich soil is used mainly as rangeland and habitat for wildlife.

The climax plant community is an open grassland dominated by tall grasses with a tolerance for salinity, variable air, and for available water levels in the soil. A few forbs, woody plants, and trees are also in these areas. Forage production is only fair because of soil blowing, wetness, salinity, and the available water capacity. Proper management, such as controlled grazing and brush control, can help maintain or improve productivity. If rangeland is properly managed wildlife is also attracted. Wildlife species in areas of this soil are deer, turkey, dove, quail, javelina, wild hogs, songbirds, coyote, bobcat, rabbits, ducks, geese, and cranes.

This soil is poorly suited to crops, pasture, and to urban and recreational uses. Soil blowing, salinity, wetness, low fertility, and the available water capacity reduce yields on improved pasture and cropland. This soil is severely restricted for urban and recreational uses by wetness, corrosiveness of uncoated steel, low strength, slow permeability, and the sandy texture.

This Dietrich soil is in capability subclass IIIw and in the Sandy Coastal Flat range site.

Ec—Edroy clay. This soil is deep, nearly level, and poorly drained. It is on uplands on weakly defined and discontinuous water courses that are 0.5 foot to 2 feet below the level of the surrounding soils. The surface is plane to slightly concave. Slopes are 0 to 1 percent, averaging less than 0.5 percent. Individual areas are mostly long and irregularly shaped, but some areas are nearly round. The long, irregular shaped areas range from about 20 to 250 acres, and the rounded areas range from about 10 to 150 acres.

Typically, the surface layer is neutral, dark gray clay about 24 inches thick. The subsoil extends to a depth of 50 inches. To a depth of 36 inches, it is mildly alkaline gray clay that has a few gray, yellow, and brown mottles, dark gray streaks, and fine calcium carbonate concretions. To a depth of 40 inches, it is mildly alkaline, grayish brown clay loam that has a few gray, yellow, and brown mottles, dark gray streaks, and fine calcium carbonate concretions. Below that, the subsoil is moderately alkaline, light brownish gray sandy clay loam that has a few yellow and brown mottles and many calcium carbonate masses and concretions. The underlying material to a depth of 72 inches is moderately alkaline, light gray sandy clay loam that has a few yellow and brown mottles and fine calcium carbonate masses and concretions.

This soil is ponded or has very slow surface runoff. Permeability is very slow, and the available water capacity is moderate. The root zone is deep, but clay content impedes movement of air, water, and roots. This soil is saturated to the surface or ponded for up to several weeks following heavy rainfall in the spring and fall. Water erosion is a slight hazard.

Included in mapping are small areas of Copano, Faddin, Inez, Orelia, Papalote, Victine, Victoria, and Vidauri soils. Also included are small areas of soils that are depressional and are ponded for extended periods. Soils that have a sandy clay loam surface layer are also included. The included soils make up less than 15 percent of the map unit.

This Edroy soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is an open grassland dominated by mid grasses with an occasional shrub or tree. Forage production is fair. Wetness is a limitation for use as rangeland and habitat for wildlife. Some quail, dove, rabbits, sandhill cranes, ducks, geese, and predatory animals are in areas of this soil. Proper management, such as controlled grazing and brush

management, can improve and help maintain productivity.

Wetness and poor soil tilth reduce yields on improved pasture and cropland. Improved varieties of bermudagrass, bluestems, kleingrass, bahiagrass, and rhodesgrass are suitable. Grain sorghum, cotton, and corn are the main cultivated crops. Fertilization, weed control, and controlled grazing improve and help maintain productivity on improved pasture. Cropping systems that include water management, fertilization, conservation tillage, cover crops, and residue management improve and help maintain soil tilth, fertility, and productivity. In some areas, simple drainage practices can remove excess water, but in other areas, a drainage system needs to be installed. Diversion terraces are needed in some areas to control runoff from surrounding higher areas.

This soil is severely restricted for urban and recreational uses. Wetness and very slow permeability affect septic tank systems. High shrink-swell potential is a limitation for building foundations and for streets and roads. Corrosiveness of uncoated steel affects installation of public utilities. Recreational facilities are affected by wetness and the clayey texture.

This Edroy soil is in capability subclass IVw and in the Claypan Prairie range site.

Ed—Edroy clay, depressional. This soil is deep, nearly level, and poorly drained. It is on uplands in round or oval, concave areas in weakly defined and discontinuous water courses. These areas are 1 foot to 8 feet below the level of the surrounding soils (fig. 8). The surface is plane to concave. Slopes are 0 to 1 percent, averaging less than 0.5 percent. Individual areas are mostly round or oval; however, some are long and irregularly shaped. The round or oval areas range from about 8 to 600 acres, and the long and irregularly shaped areas range from 10 to 150 acres.

Typically, the surface layer is neutral, dark gray clay 28 inches thick. The subsoil extends to a depth of 47 inches. It is mildly alkaline or moderately alkaline sandy clay to a depth of 42 inches. It is light brownish gray in the upper part and light gray in the lower part. Below that, the subsoil is moderately alkaline, light gray sandy clay loam. A few gray, yellow, and brown mottles are throughout the subsoil. The underlying material to a depth of 60 inches is moderately alkaline, very pale brown sandy clay loam that has a few yellow and brown mottles.

This soil is ponded with no surface runoff. Permeability is very slow, and the available water capacity is moderate. The root zone is deep, but clay content impedes movement of air, water, and roots. This soil is covered with water or is saturated to the surface about 9 or 10 months out of the year in years with normal

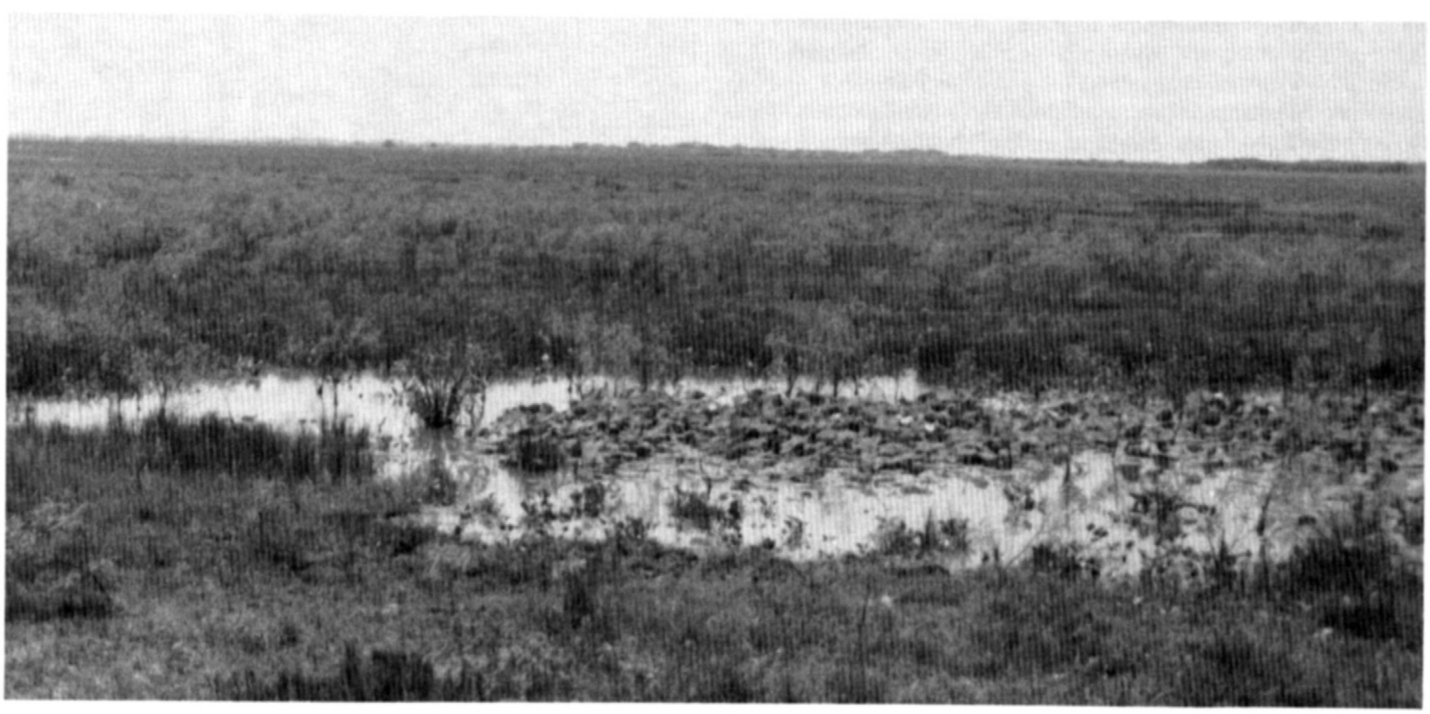


Figure 8.—Edroy clay, depressional, is about 2 feet below the level of the surrounding Victoria soils.

rainfall. In years with above normal rainfall, water ponds on the surface throughout the year. Water erosion is a slight hazard.

Included in mapping are small areas of Copano, Faddin, Inez, Orelia, Papalote, Victine, Victoria, and Vidauri soils. Also included are small areas of soils that are less depressional and are ponded for only a few days after heavy rainfall, and soils that have a sandy clay loam surface layer. The included soils make up less than 10 percent of the map unit.

This Edroy soil is used exclusively as rangeland and habitat for wildlife. In a few areas, this soil is in other uses generally because it is within areas of more suitable soils and excluding or draining the Edroy soil is not practical or economically feasible.

The climax plant community is an open grassland with varying degrees of wetness. It is dominated by mid and short grasses with a few scattered woody plants. Forage production is fair. Ponding of water and wetness are limitations for use as rangeland and as habitat for most wildlife. Some ducks, geese, and other waterfowl are attracted to areas of this soil. Controlled grazing and proper stocking improve and help maintain productivity.

This soil is severely restricted for improved pasture, crops, and urban and recreational uses because of ponding of water, wetness, poor soil tilth, high shrink-swell potential, very slow permeability, corrosiveness of uncoated steel, and the clayey texture.

This Edroy soil is in capability subclass Vw and in the Lakebed range site.

Fd—Faddin fine sandy loam. This soil is deep, nearly level to gently sloping, and somewhat poorly drained. It is on uplands. The surface is plane to slightly convex. Slopes are 0 to 1 percent, averaging about 0.5 percent. Individual areas of this soil are large and irregularly shaped and range from about 10 to 800 acres.

Typically, the surface layer is slightly acid, grayish brown fine sandy loam 19 inches thick. The subsoil extends to a depth of at least 60 inches. To a depth of 27 inches, it is slightly acid, grayish brown clay, and to a depth of 39 inches, it is slightly acid, light brownish gray sandy clay. The subsoil is mildly alkaline, light gray sandy clay to a depth of 52 inches and is calcareous, moderately alkaline, light gray sandy clay loam below that. The subsoil has mottles in shades of red, brown, and yellow in the upper part and has a few fine calcium carbonate and black concretions in the lower part.

This soil has slow surface runoff. Permeability is very slow, and the available water capacity is moderate. The root zone is deep, but the blocky structure and clayey subsoil tend to impede the movement of air, roots, and water. Water erosion is a slight hazard.

Included in mapping are small areas of Copano, Edroy, Falfurrias, Inez, Orelia, Papalote, Sarita, Victoria, and Vidauri soils. Also included are small areas of soils that have slopes of more than 1 percent and soils that have a loamy fine sand surface layer. The included soils make up less than 15 percent of the map unit.

This Faddin soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is an open grassland dominated by mid and tall grasses. Forage production on rangeland and improved pasture is high. Deer, quail, dove, rabbits, and predatory animals are attracted to these areas. Improved varieties of bermudagrass, bluestem, bahiagrass, rhodesgrass, and kleingrass are the main pasture grasses. Proper management, such as controlled grazing and proper stocking on rangeland and fertilization, weed control, and controlled grazing on improved pasture, help maintain high productivity.

Wetness and low fertility reduce yields on cropland. Grain sorghum, cotton, and corn are the major cultivated crops. Cropping systems should include water management, fertilization, conservation tillage, cover crops, and residue management to improve and help maintain fertility and productivity. Simple drainage practices can remove most of the excess water in this soil, but diversion terraces are needed in some areas to control runoff.

This soil is severely restricted for urban and recreational uses. Wetness and very slow permeability affect septic tank systems. Shrinking and swelling and low strength are limitations for building foundations and for streets and roads. High corrosiveness of uncoated steel affects installation of public utilities. Recreational facilities are affected by wetness and very slow permeability.

This Faddin soil is in capability subclass IIw and in the Loamy Prairie range site.

FfC—Falfurrias fine sand, 0 to 5 percent slopes. This soil is deep, nearly level to gently undulating, and somewhat excessively drained. It is on terraces, uplands, and along the mainland coastline. The surface is plane to convex, hummocky, and dune-like. Slopes average about 3 percent. Individual areas are long and irregularly shaped and range from about 25 to 200 acres.

Typically, the surface layer is neutral fine sand about 30 inches thick. It is pale brown in the upper part and very pale brown in the lower part. The underlying material to a depth of 99 inches is neutral, very pale brown fine sand.

This soil has very slow or no surface runoff. Permeability is rapid, and the available water capacity is low. The root zone is deep, but the low available water capacity restricts plant species and growth. Areas along the mainland coastline are subjected to wind blown saltwater spray and mist, but because occurrences are infrequent, rainfall is adequate for leaching. Also, the soils are rapidly permeable and are not much affected by salt. Soil blowing is a severe hazard, and water erosion is a slight hazard.

Included in mapping are small areas of Dietrich, Galveston, Mustang, Papalote, and Sarita soils. Also included are small areas of soils that have slopes of more than 5 percent and soils that have a loamy fine sand surface layer. Small areas of active dunes are in this map unit. The included soils make up less than 15 percent of the map unit.

This Falfurrias soil is used mainly as rangeland and habitat for wildlife.

The climax plant community is an open grassland dominated by tall and mid grasses and motts of live oak or mesquite trees. Forage production is only fair because of soil blowing and the low available water capacity. Some quail, dove, songbirds, rabbits, fox, and predatory animals inhabit these areas. Proper management, such as controlled grazing and proper stocking, can improve and help maintain productivity.

This soil is severely restricted for improved pasture, crops, and for urban and recreational uses. Low fertility, low available water capacity, and soil blowing severely reduce yields on pasture and cropland. The sandy texture, stability, and seepage affect urban uses. Recreational uses are restricted by the sandy texture.

This Falfurrias soil is in capability subclass VIIe and in the Sandy Hill range site.

GmB—Galveston-Mustang fine sands, 0 to 3 percent slopes. The soils of this complex are on low coastal plains. The surface is hummocky to gently undulating and convex or plane and slightly concave. Elevation above sea level ranges from about 4 to 30 feet. Slopes average about 0.75 percent. Individual areas are broad and irregularly shaped and range from about 75 to 400 acres. The Galveston and Mustang soils are too intricately mixed to be mapped separately at the selected scale.

Galveston soil makes up about 55 percent of this map unit. It is on hummocky to gently undulating, convex plains. Typically, the surface layer is neutral, gray fine sand about 4 inches thick. The underlying material to a depth of 80 inches is mildly alkaline fine sand that is light gray in the upper part and white in the lower part. A few yellow mottles and shell fragments are throughout the underlying material.

This soil is somewhat excessively drained and has very slow or no surface runoff. Permeability is rapid above the high water table, and the available water capacity is low. A permanent high water table fluctuates somewhat with the tides, but it is usually at a depth of 40 to 72 inches. The high water table is at or near the surface for several days to about a week following heavy rainfall. The root zone is deep, but the high water table and low available water capacity impede movement of roots. Elevation of this soil ranges from about 5 to 30 feet above sea level. Soil blowing is a severe hazard, and water erosion is a slight hazard. This soil is occasionally flooded.

Mustang soil makes up about 35 percent of this map unit. It is on plane to slightly concave plains. Typically, the surface layer is mildly alkaline, light brownish gray fine sand about 6 inches thick. It has a few shell fragments. The underlying material to a depth of 80 inches is mildly alkaline fine sand that is light gray in the upper part and white in the lower part. Shell fragments and yellow mottles and streaks are throughout the underlying material.

This soil is poorly drained and has very slow surface runoff. Permeability is rapid above the high water table, and the available water capacity is low. A permanent high water table fluctuates somewhat with the tides, but it is usually within 36 inches of the soil surface. The root zone is deep, but the permanent high water table and low available water capacity impede movement of roots. Elevation of this soil ranges from 4 to about 10 feet above sea level. This soil is seldom dry below a depth of about 10 inches, and following heavy rainfall, it is covered with water or saturated to the surface for periods of several days to several weeks. Soil blowing is a severe hazard, and water erosion is a slight hazard. This soil is occasionally flooded.

Included in mapping are small areas of Dietrich, Falfurrias, Narta, Orelia, Victine, and Victoria soils. Also included are small areas of Galveston and Mustang soils that have a loamy fine sand or loamy sand surface layer. The included soils make up less than 10 percent of the map unit.

The soils of this complex are used exclusively as habitat for wildlife and as rangeland. Some deer, javelina, turkey, wild hogs, rabbits, and predatory animals inhabit the more inland parts of this complex, and some ducks, geese, egrets, herons, and cranes are in the areas nearer the coast.

The climax plant community is a mixture of open grassland dominated by tall grasses with a few scattered shrubs on the Galveston soil and open, wet grassland of mixed grasses with a few scattered woody plants, a few forbs, and some reeds, sedges, and rushes on the Mustang soil. Most of the plants are water tolerant. The climax vegetation varies with the frequency of flooding, depth of water coverage, duration of coverage, and depth to the permanent high water table. Flooding, wetness, the high water table, low available water capacity, soil blowing, and low fertility make the soils of this complex poorly suited to use as rangeland. Proper management, such as controlled grazing, proper stocking, and brush management, help to maintain and improve productivity.

The soils of this complex are severely restricted for improved pasture, crops, and for urban and recreational uses. Flooding, wetness, the high water table, low fertility, and soil blowing affect pasture and cropland productivity. Flooding, wetness, the high water table, corrosiveness of uncoated steel, and the sandy texture affect urban and recreational uses.

This complex is in capability subclass VIe. The Galveston soil is in the Coastal Sand range site, and the Mustang soil is in the Low Coastal Sand range site.

In—Inez fine sandy loam. This soil is deep, nearly level, and somewhat poorly drained. It is on uplands and terraces bordering streams. The surface is plane to slightly concave. Slopes are less than 1 percent, averaging about 0.5 percent. Individual areas are broad and irregularly shaped and range from about 50 to 150 acres.

Typically, the surface layer is slightly acid, light brownish gray fine sandy loam 10 inches thick. It has a few yellow mottles. The subsurface layer is slightly acid, light gray fine sandy loam that has a few yellow and brown mottles. The subsoil extends to a depth of 64 inches. To a depth of 36 inches, it is medium acid to strongly acid clay. The upper part of this layer is light brownish gray, and the lower part is light gray with mottles in shades of brown, gray, yellow, and red. A few dark gray streaks are in this layer. To a depth of 48 inches, the subsoil is slightly acid, light gray sandy clay that has mottles in shades of brown and yellow, a few dark gray streaks, and a few black concretions and masses. Below that, the subsoil is mildly alkaline, light gray sandy clay loam that has a few mottles in shades of brown and yellow and a few black concretions and masses.

This soil has slow surface runoff. Permeability is very slow, and the available water capacity is high. The root zone is deep, but clay content impedes movement of air, water, and roots. This soil is wet or saturated to the surface for periods of several days to several weeks following heavy rainfall. A perched high water table is at a depth of less than 18 inches during the fall, winter, and spring of most years, but this soil is dry during the summer. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Copano, Edroy, Faddin, Falfurrias, Odem, Orelia, Papalote, Sarita, Victoria, Vidauri, and Wyick soils. Also included are small areas of soils that have slopes of more than 1 percent and soils that have a loamy fine sand surface layer. The included soils make up less than 15 percent of the map unit.

This Inez soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is a savannah with 20 to 35 percent tree canopy cover and an understory dominated by mid and tall grasses. Forage production is high. Because of the abundant forage and good cover, numerous deer, turkey, quail, dove, rabbits, squirrels, songbirds, fox, bobcat, predatory animals and birds, and some wetland species inhabit these areas. Proper management, such as controlled grazing, proper stocking, and brush management, help to maintain productivity.

Wetness and low fertility reduce yields on improved pasture and cropland. Improved varieties of bermudagrass, bluestem, kleingrass, and bahiagrass are the main pasture grasses, and grain sorghum, cotton, and corn are the major cultivated crops. Fertilization, weed control, proper stocking, and controlled grazing improve and help maintain productivity of improved pastures. Cropping systems that include water management, fertilization, cover crops, conservation tillage, and residue management improve and help maintain fertility and productivity. In some areas, simple drainage practices can remove excess water, but in other areas, a drainage system, land leveling, or land smoothing are needed for water management. Diversion terraces are desirable in some areas to control runoff from higher areas.

This soil is severely restricted for urban and recreational uses. Wetness and very slow permeability affect septic tank systems. Shrinking and swelling and wetness are limitations for building foundations and for streets and roads. High corrosiveness of uncoated steel affects installation of public utilities. Recreational facilities are affected by the very slow permeability and wetness of this soil.

This Inez soil is in capability subclass IIIw and in the Sandy Loam range site.

MoC—Monteola clay, 3 to 5 percent slopes. This soil is deep, gently sloping, and moderately well drained. It is on uplands. The surface is plane to slightly convex. Slopes average about 4 percent. Individual areas are long and narrow and range from about 15 to 75 acres.

Typically, the surface layer is moderately alkaline clay about 33 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The subsoil extends to a depth of 58 inches. It is moderately alkaline, gray clay that has very pale brown streaks, a few calcium carbonate concretions and masses, and a few gypsum crystals in the lower part. The underlying material to a depth of 72 inches is moderately alkaline, slightly saline, very pale brown clay that has a few dark streaks, common calcium carbonate concretions and masses, and seams and pockets of gypsum crystals.

This soil has slow to medium surface runoff. Permeability is very slow. Water enters the soil rapidly when it is dry and cracked and very slowly when it is moist. The available water capacity is moderate. The root zone is deep, but clay content impedes movement of air, water, and roots. Water erosion is a severe hazard.

Included in mapping are small areas of Narta, Orelia, Papalote, Victine, and Victoria soils. Also included are small areas of soils that have slopes of 5 to 8 percent, soils that have a clay loam surface layer, and soils that have had 25 percent or more of the surface layer removed by water erosion. The included soils make up less than 15 percent of the map unit.

This Monteola soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used for improved pasture or cropland.

The climax plant community is an open grassland dominated by mid and short grasses with a few scattered woody plants. Forage production is low. Most areas are dominated by brush and other woody plants. The hazard of water erosion and the available water capacity are limitations. Some quail, dove, songbirds, rabbits, and predatory animals inhabit the areas of this soil. Proper management, such as controlled grazing, proper stocking, and brush management, help control surface runoff and erosion and improve and maintain productivity.

Available water capacity and poor soil tilth severely reduce yields on improved pasture and cropland. The slope and hazard of water erosion are also limitations. Improved varieties of bermudagrass are the main pasture grasses, and grain sorghum is the major cultivated crop. Fertilization, weed control, controlled grazing, and proper stocking help control surface runoff and erosion and improve and maintain productivity of improved pastures. Cropping systems that include water management, fertilization, conservation tillage, cover crops, and residue management improve and help maintain soil tilth, fertility, and productivity. Farming on the contour and a properly installed terrace and waterway system help control surface runoff and reduce the water erosion hazard. Diversion terraces are needed in some areas to control runoff.

This soil is severely restricted for urban and recreational uses. Very slow permeability affects septic tank systems. High shrink-swell potential and low strength are limitations for building foundations and for streets and roads. Corrosiveness of uncoated steel affects installation of public utilities. Recreational facilities are affected by the slope, very slow permeability, and the clayey texture of this soil.

This Monteola soil is in capability subclass IIIe and in the Rolling Blackland range site.

MoD4—Monteola clay, 5 to 8 percent slopes, gullied. This soil is deep, moderately sloping, and moderately well drained. It is on eroded uplands. The surface is slightly convex. Slopes average about 6 percent. Individual areas are long and narrow and range from about 15 to 50 acres.

Typically the surface layer is moderately alkaline, dark gray clay 12 inches thick. It has a few calcium carbonate concretions. The subsoil extends to a depth of 36 inches. It is is moderately alkaline, very slightly saline, grayish brown clay that has dark gray and very dark gray streaks, a few calcium carbonate concretions and masses, and a few gypsum crystals. The underlying material to a depth of 60 inches is moderately alkaline, slightly saline, pale brown clay that has a few gray streaks, calcium carbonate concretions and masses, and a few seams and pockets of gypsum crystals.

This soil has medium to rapid surface runoff. Permeability is very slow. Water enters the soil rapidly when it is dry and cracked and very slowly when it is moist. The available water capacity is moderate. The root zone is deep, but clay content impedes movement of water, roots, and air. Water erosion is a severe hazard.

Gullies that range from 1 foot to 20 feet deep and 1 foot to 50 feet wide occur 15 to 400 feet apart. They make up about 5 to 40 percent of most areas. Most of soil between gullies has had 25 percent or more of the surface layer removed by water erosion. In gullied areas, intensive measures, such as reshaping, are needed to reclaim the soil.

Included in mapping are small areas of Papalote and Victoria soils. Also included are small areas of soils that have slopes of 3 to 5 percent, local areas that are not gullied, and small areas of soils that have a clay loam surface layer. The included soils make up less than 20 percent of the map unit.

This Monteola soil is used mainly as rangeland and habitat for wildlife.

The climax plant community is an open grassland dominated by mid and short grasses and a few scattered woody plants. Forage production is low. Most areas are dominated by brush and other woody plants. The slope, hazard of water erosion, and available water capacity are limitations. Some quail, dove, songbirds, rabbits, and predatory animals inhabit areas of this soil. Proper management, such as controlled grazing, proper stocking, and brush management, help control surface runoff and erosion and improve and maintain productivity.

This soil is severely restricted for improved pasture, crops, and for urban and recreational uses. The slope, erosion hazard, available water capacity, and poor soil tilth affect improved pasture and cropland productivity. Very slow permeability, low strength, high shrink-swell potential, slope, corrosiveness of uncoated steel, and the clayey texture affect urban and recreational uses.

This Monteola soil is in capability subclass VIe and in the Rolling Blackland range site.

Na—Narta fine sandy loam. This soil is deep, nearly level, and somewhat poorly drained. It is on low coastal plains. The surface is plane to slightly concave. Elevation above sea level ranges from about 4 to 30 feet. Slopes are 0 to 1 percent, averaging less than 0.5 percent. Individual areas are irregularly shaped and range from about 15 to 250 acres.

Typically, the surface layer is moderately alkaline, slightly saline, grayish brown fine sandy loam 7 inches thick. The subsoil extends to a depth of 54 inches. It is moderately alkaline, moderately saline, clay to a depth of 42 inches. It is dark gray in the upper part. In the lower

part, it is gray with a few fine calcium carbonate concretions and a few seams of salt crystals. From 42 to 54 inches, the subsoil is strongly alkaline, moderately saline, gray clay that has common calcium carbonate concretions, a few black concretions, and a few seams of salt crystals. The underlying material to a depth of 60 inches is strongly alkaline, moderately saline, light gray clay loam. It has common calcium carbonate concretions, a few black concretions, and a few seams of salt crystals.

This soil has very slow surface runoff or is ponded. Permeability is very slow. The available water capacity is low because of salinity. The root zone is deep, but salinity and clay content impede movement of roots, air, and water. In some areas, this soil is occasionally flooded by salt water for short periods by high storm tides. It is saturated to the surface for periods of several days to a month or more following heavy rainfall. A perched high water table is at a depth of less than 6 inches during fall, winter, and spring of most years. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Copano, Edroy, Faddin, Orelia, Papalote, Victine, Victoria, and Vidauri soils. Also included are small areas of soils that have slopes of more than 1 percent and soils that have a sandy clay loam or clay loam surface layer. The included soils make up less than 10 percent of the map unit.

This Narta soil is used mainly as rangeland and habitat for wildlife.

The climax plant community is an open grassland dominated by salt-tolerant plants (fig. 9). Forage production is only fair because of wetness and salinity. Some areas are dominated by brush and other woody plants because of overgrazing. Because of the narrow range of plants on this soil, wildlife is limited. Some waterfowl and a few deer, wild hogs, rabbits, and predatory animals inhabit these areas. Proper management, such as controlled grazing, proper stocking, and brush management, can improve and maintain productivity.

This soil is not recommended for use as improved pasture or cropland. Salinity, wetness, low available water capacity, and poor soil tilth severely reduce yields.

This soil is severely restricted for urban and recreational uses by salinity, wetness, very slow permeability, shrinking and swelling, low strength, and corrosiveness of uncoated steel.

Figure 9.—This grassland area of Narta fine sandy loam along the north shore of Copano Bay is dominated by salt-tolerant plants. This soil is saline throughout.

This Narta soil is in capability subclass VIs and in the Salty Prairie range site.

Od—Odem fine sandy loam, occasionally flooded. This soil is deep, nearly level to gently sloping, and well drained. It is on flood plains and natural levees or terraces along streams. The surface is plane to convex. Slopes range from 0 to 2 percent, averaging about 0.5 percent. Individual areas are irregularly shaped and are parallel and adjacent to river and creek channels. They range from about 10 to 140 acres.

Typically, the surface layer is mildly alkaline or neutral fine sandy loam 36 inches thick. It is dark gray in the upper part and dark grayish brown in the lower part. The underlying material to a depth of 68 inches is neutral, very pale brown fine sandy loam that has a few bedding planes and thin strata of loamy fine sand and fine sand.

This soil has slow surface runoff. Permeability is moderately rapid, and the available water capacity is moderate. The root zone is deep. This soil is occasionally flooded following periods of high rainfall. It is inundated for a few hours to a few days once or twice each 10 years. Soil blowing is a moderate hazard, and water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Edroy, Falfurrias, Monteola, Orelia, Papalote, Sinton, and Victoria soils. Also included are small areas of soils that have slopes of more than 2 percent, soils that have a surface layer that is lighter in color than that of the Odem soil, and soils that have a loam or loamy fine sand surface layer. The included soils make up less than 10 percent of the map unit.

This Odem soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is a mixture of grasses, trees, shrubs, and forbs. Forage production is high. The wide variety of plants attracts numerous deer, turkey, javelina, rabbits, quail, dove, songbirds, and predatory animals. Proper management, such as controlled grazing, proper stocking, and brush management, can help maintain high productivity.

Occasional flooding, low fertility, available water capacity, and soil blowing reduce yields on improved pasture and cropland. Improved varieties of bermudagrass, bluestems, lovegrass, kleingrass, and buffelgrass are the main pasture grasses, and grain sorghum, cotton, and corn are the main cultivated crops. Fertilization, weed control, controlled grazing, proper stocking, and brush management can improve and help maintain pasture productivity. Cropping systems that include water management, fertilization, conservation tillage, cover crops, and residue management reduce soil blowing, conserve moisture, and improve and maintain fertility and productivity. Diversion terraces are needed in some areas to control runoff from adjoining uplands. Levees are necessary in all areas to protect against occasional flooding by streams.

This soil is severely restricted for urban uses because of occasional flooding and seepage. Occasional flooding is also a moderate limitation for recreational uses.

This Odem soil is in capability subclass IIw and in the Loamy Bottomland range site.

Or—Orelia fine sandy loam. This soil is deep, nearly level, and somewhat poorly drained. It is on uplands. The surface is plane to slightly concave. Slopes are 0 to 1 percent, averaging about 0.5 percent. Individual areas of this soil are large and irregularly shaped and range from about 10 to 1,200 acres.

Typically, the surface layer is slightly acid, gray fine sandy loam 6 inches thick. The subsoil extends to a depth of 37 inches. To a depth of 20 inches, it is very dark gray sandy clay loam that is neutral in the upper part and mildly alkaline in the lower part. Below that, it is moderately alkaline, gray sandy clay loam. The underlying material to a depth of 60 inches is moderately alkaline, light gray sandy clay loam.

This soil has slow surface runoff. Permeability is very slow, and the available water capacity is moderate. The root zone is deep, but the blocky structure of the subsoil tends to impede the movement of air, roots, and water. In some areas, the soil is saturated with water to a depth of about 1 foot for periods of as long as 30 days during spring and fall of most years. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Copano, Edroy, Faddin, Inez, Narta, Papalote, Victine, Victoria, Vidauri, and Wyick soils. Also included are small areas of soils that have a sandy clay loam or clay loam surface layer, soils that have slopes of more than 1 percent, and soils that have a more clayey subsoil than the Orelia soil. The included soils make up less than 20 percent of the map unit.

This Orelia soil is used mainly as rangeland and habitat for wildlife. In some areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid grasses with an occasional shrub or tree. Forage production is only fair because of wetness. Some areas are dominated by brush and other woody plants because of overgrazing. Some deer, quail, dove, turkey, javelina, wild hogs, rabbits, songbirds, predatory animals, and a few wetland wildlife species inhabit the areas of this soil. Proper management, such as controlled grazing, proper stocking, and brush management, can improve and help maintain productivity.

Wetness, salinity, and poor soil tilth reduce yields on cropland and improved pasture. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestem, rhodesgrass, bahiagrass, and kleingrass are the main pasture grasses.

Cropping systems that include water management, fertilization, cover crops, conservation tillage, and residue management improve and help maintain productivity. In some areas, simple drainage practices remove excess water, but in most areas, a drainage system needs to be installed. Fertilization, weed control, proper stocking, and controlled grazing improve and help maintain pasture productivity.

This soil is severely restricted for urban and recreational uses. Wetness and very slow permeability affect septic tank systems. Shrinking and swelling and low strength are limitations for building foundations and for streets and roads. High corrosiveness of uncoated steel affects installation of public utilities. Recreational facilities are affected by the wetness and very slow permeability of this soil.

This Orelia soil is in capability subclass IIIw and in the Claypan Prairie range site.

PaB—Papalote loamy fine sand, 0 to 3 percent slopes. This soil is deep, nearly level to gently sloping, and moderately well drained. It is on uplands. The surface is plane to slightly convex and hummocky. Slopes average about 1.5 percent. Individual areas of this soil are mostly broad and irregularly shaped and range from about 10 to 950 acres.

Typically, the surface layer is slightly acid, grayish brown loamy fine sand 14 inches thick. The subsoil extends to a depth of 48 inches. To a depth of 30 inches, it is clay that has a few mottles in shades of gray, brown, and yellow. It is slightly acid and dark grayish brown in the upper part and neutral and brown in the lower part. To a depth of 38 inches, the subsoil is mildly alkaline, pinkish gray sandy clay that has common mottles in shades of yellow and brown and a few gray mottles. Below that, the subsoil is moderately alkaline, light brownish gray sandy clay loam that has a few concretions of calcium carbonate. The underlying material to a depth of 60 inches is moderately alkaline, white sandy clay loam that has a few concretions of calcium carbonate.

This soil has slow surface runoff. Permeability is slow, and the available water capacity is moderate. The root zone is deep, but the blocky structure of the subsoil tends to impede the movement of air, roots, and water. Soil blowing is a severe hazard, and water erosion is a slight hazard.

Included in mapping are small areas of Copano, Edroy, Faddin, Falfurrias, Inez, Orelia, Sarita, Victoria, and Vidauri soils. Also included are small areas of soils that have slopes of more than 3 percent, soils that have a fine sandy loam surface layer, and soils that have a fine sand surface layer and less clayey subsoil than the Papalote soil. The included soils make up less than 15 percent of the map unit.

This Papalote soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is an open grassland dominated by mid and tall grasses and a few scattered trees and shrubs. Forage production is only fair because of soil blowing and droughtiness. Numerous deer, turkey, javelina, quail, dove, rabbits, and predatory animals inhabit these areas. Proper management, such as controlled grazing, proper stocking, and brush management, can improve and help maintain productivity.

Soil blowing, low fertility, and available water capacity reduce yields on improved pasture and severely restrict use of this soil as cropland. Improved varieties of bermudagrass, lovegrass, bahiagrass, bluestem, and buffelgrass are the main pasture grasses, and grain sorghum is the major cultivated crop. Fertilization, weed control, controlled grazing, and proper stocking improve and help maintain pasture productivity. Cropping systems that include fertilization, cover crops, conservation tillage, and residue management help control soil blowing, conserve moisture, and improve and maintain fertility and productivity.

This soil is restricted for urban uses, but it is only slightly restricted for recreational uses. Slow permeability affects septic tank systems. Shrinking and swelling, low strength, and the clayey texture are limitations for building foundations and for streets and roads. Corrosiveness of uncoated steel affects installation of public utilities.

This Papalote soil is in capability subclass IIIe and in the Loamy Sand range site.

PtA—Papalote fine sandy loam, 0 to 1 percent slopes. This soil is deep, nearly level, and moderately well drained. It is on uplands. The surface is plane to slightly convex. Slopes average about 0.5 percent. Individual areas of this soil are irregularly shaped and range from about 10 to 1,400 acres.

Typically, the surface layer is neutral, grayish brown fine sandy loam 11 inches thick. The subsoil extends to a depth of 52 inches. To a depth of 18 inches, it is neutral, grayish brown clay that has a few gray and common yellowish brown mottles. To a depth of 31 inches, the subsoil is mildly alkaline, light brownish gray sandy clay that has a few gray mottles and common brownish yellow and yellowish brown mottles. Below that, it is mildly alkaline or moderately alkaline, light gray sandy clay in the upper part and very pale brown sandy clay loam in the lower part. A few concretions of calcium carbonate are in the lower part. The underlying material to a depth of 60 inches is moderately alkaline, very pale brown sandy clay loam that has a few concretions of calcium carbonate.

This soil has slow to moderate surface runoff. Permeability is slow, and the available water capacity is

moderate. The root zone is deep, but the blocky structure of the subsoil tends to impede the movement of air, roots, and water. Water erosion is a slight hazard.

Included in mapping are small areas of Copano, Edroy, Faddin, Inez, Narta, Orelia, Victoria, and Vidauri soils. Also included are small areas of soils that have slopes of more than 1 percent, soils that have a loamy fine sand surface layer, and soils that have a thin surface layer and less clayey subsoil than the Papalote soil. The included soils make up less than 15 percent of the map unit.

This Papalote soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid grasses and a few scattered trees and shrubs. Forage production is only fair because of droughtiness. Numerous deer, turkey, quail, dove, javelina, rabbits, songbirds, and predatory animals inhabit these areas. Proper management, such as controlled grazing, proper stocking, and brush management, can improve and help maintain productivity.

The moderate available water capacity and low fertility reduce yields on cropland and improved pasture. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestem, bahiagrass, rhodesgrass, and kleingrass are the main pasture grasses. Cropping systems that include fertilization, cover crops, conservation tillage, and residue management help conserve moisture and improve and maintain fertility and productivity. Fertilization, weed control, controlled grazing, and proper stocking improve and help maintain pasture productivity.

This soil is restricted for urban uses, but it is only slightly restricted for recreational uses (fig. 10). Slow permeability affects septic tank systems. Shrinking and swelling, low strength, and the clayey texture affect building foundations and streets and roads. Corrosiveness of uncoated steel affects installation of public utilities.

This Papalote soil is in capability subclass IIs and in the Tight Sandy Loam range site.

PtB—Papalote fine sandy loam, 1 to 3 percent slopes. This soil is deep, gently sloping to gently

Figure 10.—Papalote fine sandy loam, 0 to 1 percent slopes, is well suited to recreational uses, such as this golf course.

undulating, and moderately well drained. It is on uplands. The surface is plane to slightly convex. Slopes average about 2 percent. Individual areas of this soil are mostly long and narrow along slope breaks and range from about 10 to 175 acres.

Typically, the surface layer is slightly acid, grayish brown fine sandy loam about 10 inches thick. The subsoil extends to a depth of about 49 inches. To a depth of 39 inches, it is sandy clay that is grayish brown and slightly acid in the upper part and pale brown and neutral in the lower part. Mottles in shades of gray, yellow, and brown are in the upper part. Below that, the subsoil is moderately alkaline, light brownish sandy clay loam that has a few concretions of calcium carbonate. The underlying material to a depth of 60 inches is moderately alkaline, white sandy clay loam that has a few concretions of calcium carbonate.

This soil has moderate surface runoff. Permeability is slow, and the available water capacity is moderate. The root zone is deep, but the blocky structure of the subsoil tends to impede the movement of air, roots, and water. Water erosion is a moderate hazard.

Included in mapping are small areas of Copano, Faddin, Inez, Victoria, and Vidauri soils. Also included are small areas of soils that have slopes of less than 1 percent, soils that have slopes of more than 3 percent, soils that have 25 percent of the surface layer removed by water erosion, and soils that have a loamy fine sand surface layer. Small areas of soils that have a thin surface layer and less clayey subsoil than the Papalote soils are also included. The included soils make up less than 15 percent of the map unit.

This Papalote soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid grasses with a few scattered trees and shrubs. Forage production is only fair because of water erosion and droughtiness. Numerous deer, turkey, javelina, rabbits, quail, dove, songbirds, and predatory animals inhabit these areas. Proper management, such as controlled grazing, proper stocking, and brush management, improve and maintain productivity.

Water erosion, available water capacity, and low fertility reduce yields on cropland and improved pasture. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestem, bahiagrass, rhodesgrass, and kleingrass are the main pasture grasses. Water management, fertilization, cover crops, conservation tillage, and residue management help to conserve moisture and improve and maintain fertility and productivity. Contour tillage and a properly installed terrace and waterway system help control surface runoff and reduce the water erosion hazard. Diversion terraces are desirable in some areas to control runoff. Fertilization, weed control, controlled grazing, and proper stocking help control surface runoff and erosion, conserve moisture, and improve and maintain fertility and productivity of improved pastures.

This soil is restricted for urban and recreational uses. Slow permeability affects septic tank systems. Shrinking and swelling of the soil, low strength, and the clayey texture affect building foundations and streets and roads. Corrosiveness of uncoated steel affects installation of public utilities. Slopes of 2 percent or more restrict the use of this soil for playgrounds.

This Papalote soil is in capability subclass IIe and in the Tight Sandy Loam range site.

PtC—Papalote fine sandy loam, 3 to 5 percent slopes. This soil is deep, gently sloping to gently undulating, and moderately well drained. It is on uplands. The surface is plane to convex. Slopes average about 4 percent. Individual areas of this soil are mainly long and narrow along slope breaks and range from about 10 to 100 acres.

Typically, the surface layer is neutral, grayish brown fine sandy loam 11 inches thick. The subsoil extends to a depth of 36 inches. To a depth of 23 inches, it is neutral sandy clay that is grayish brown in the upper part and pale brown in the lower part. A few gray mottles and common mottles in shades of brown and yellow are in this layer. To a depth of 36 inches, the subsoil is mildly alkaline, very pale brown sandy clay loam. This layer has a few black concretions. The underlying material to a depth of 48 inches is moderately alkaline, white sandy clay loam. It has a few calcium carbonate concretions and masses and a few black concretions.

This soil has rapid surface runoff. Permeability is slow, and the available water capacity is moderate. The root zone is deep, but the blocky structure of the subsoil tends to impede the movement of air, roots, and water. Water erosion is a severe hazard.

Included in mapping are small areas of Copano, Faddin, Falfurrias, and Sarita soils. Also included are small areas of soils that have slopes of less than 3 percent; soils that have slopes of more than 5 percent; soils that have 25 percent or more of the surface layer removed by water erosion, rills, and shallow gullies; and soils that have a loamy fine sand surface layer. The included soils make up less than 20 percent of the map unit.

This Papalote soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is an open grassland dominated by mid grasses and a few scattered trees and shrubs. Forage production is only fair because of water erosion and droughtiness. Numerous deer, turkey, javelina, quail, dove, songbirds, and predatory animals inhabit these areas. Proper management, such as controlled grazing, proper stocking, and brush

management, can improve and help maintain productivity.

Water erosion, available water capacity, low fertility, and slope reduce yields on improved pasture and severely reduce yields on cropland. Improved varieties of bermudagrass and bluestem are the main pasture grasses, and grain sorghum is the major cultivated crop. Fertilization, weed control, controlled grazing, and proper stocking help control runoff and erosion, conserve moisture, and improve and maintain fertility and productivity of improved pastures. Cropping systems that include water management, fertilization, cover crops, conservation tillage, and residue management help conserve moisture and improve and maintain fertility and productivity. Contour farming and a properly installed terrace and waterway system help control surface runoff and reduce the water erosion hazard. Diversion terraces are needed in most areas of this soil to control runoff.

This soil is restricted for urban and recreational uses. Slow permeability affects septic tank systems. Shrinking and swelling and the clayey texture are limitations for building foundations, and low strength is a limitation for streets and roads. Corrosiveness of uncoated steel affects installation of public utilities. Slopes of 2 percent or more restrict the use of this soil for playgrounds.

This Papalote soil is in capability subclass IIIe and in the Tight Sandy Loam range site.

SfC—Sarita-Falfurrias fine sands, 0 to 5 percent slopes. The soils of this complex are on nearly level to undulating stream terraces and uplands. The surface is plane to duned and is slightly convex. Slopes average about 3 percent. Individual areas of this complex are broad and irregularly shaped. They range from about 50 to 300 acres. The Sarita and Falfurrias soils are too intricately mixed to be mapped separately at the selected scale.

Sarita soil makes up about 43 percent of the map unit. This soil is well drained. It is on the hummocky to gently undulating and slightly convex uplands and stream terraces. Typically, the surface layer is slightly acid, light brownish gray fine sand 10 inches thick. The subsurface layer is light gray fine sand to a depth of 50 inches. The subsoil extends to a depth of at least 72 inches. To a depth of 62 inches, it is neutral sandy clay loam that is light brownish gray in the upper part and light gray in the lower part. This layer has mottles in shades of yellow and brown throughout. The subsoil below a depth of 62 inches is moderately alkaline, light gray fine sandy loam that has a few mottles in shades of yellow.

This soil has very slow or no surface runoff. Permeability is moderately rapid, and the available water capacity is low. The root zone is deep, but the low available water capacity limits plant species. Soil blowing is a severe hazard, and water erosion is a slight hazard.

Falfurrias soil makes up 33 percent of the map unit. This soil is somewhat excessively drained. It is on the higher duned uplands and terraces. The surface layer is 30 inches thick. It is neutral, pale brown fine sand to a depth of 9 inches and neutral, very pale brown fine sand below that. The underlying material to a depth of 99 inches is neutral, very pale brown fine sand.

This soil has very slow or no surface runoff. Permeability is rapid, and the available water capacity is low. The root zone is deep, but the low available water capacity limits plant species. Soil blowing is a severe hazard, and water erosion is a slight hazard.

Included in mapping are small areas of Copano, Edroy, Faddin, Inez, Odem, Papalote, and Vidauri soils. Also included are small areas of soils that have a loamy fine sand surface layer, a few areas of soils that have a sandy surface layer less than 40 inches thick, and a few small areas of soils that have slopes of more than 5 percent. The included soils make up less than 30 percent of the map unit.

The soils of this complex are used mainly as rangeland and habitat for wildlife. Some deer, turkey, javelina, rabbits, quail, dove, songbirds, and predatory animals inhabit the areas of these soils.

The climax plant community is an open grassland dominated by mid and tall grasses and a few scattered trees on the Sarita soil, and motts of live oak or mesquite trees on the Falfurrias soil. Forage production is only fair because of soil blowing, low fertility, and droughtiness. Proper stocking and controlled grazing help conserve moisture, control soil blowing, and improve and maintain fertility and productivity.

The soils of this complex are severely restricted for improved pasture, crops, and for urban and recreational uses. Soil blowing, low fertility, and low available water capacity affect pasture and cropland productivity. The sandy texture, seepage, poor filter, and caving of cutbanks affect urban and recreational uses.

This complex is in capability subclass VIIe. The Sarita soil is in the Sandy range site, and the Falfurrias soil is in the Sandy Hill range site.

Sn—Sinton clay loam, occasionally flooded. This soil is deep, nearly level, and well drained. It is on flood plains. The surface is plane to slightly convex. Slopes are less than 1 percent, averaging about 0.5 percent. This soil is in long, narrow bands and cresent-shaped areas along rivers and creeks. Individual areas of this soil range from about 10 to 200 acres.

Typically, the surface layer is 35 inches thick. It is dark gray clay loam in the upper part and dark grayish brown sandy clay loam in the lower part. The underlying material extends to a depth of at least 70 inches. To a depth of 60 inches, it is light brownish gray sandy clay loam that has thin lenses of silt and fine sandy loam and films and threads of calcium carbonate. Below that, it is very pale brown fine sandy loam that has thin lenses of loam, a few bedding planes, and a few films and threads of calcium carbonate. This soil is moderately alkaline

throughout. Snail shells and shell fragments are throughout the profile.

This soil has slow surface runoff. Permeability is moderate, and the available water capacity is high. The root zone is deep. This soil is occasionally flooded during periods of heavy rainfall. It is inundated from a few hours to a few days once or twice every 10 years. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Edroy, Falfurrias, Odem, and Sarita soils. Also included are small areas of soils that have slopes of more than 1 percent, soils that are frequently flooded, and soils that have less than 6 inches of sandy overwash from adjacent uplands. The included soils make up less than 15 percent of the map unit.

This Sinton soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture or cropland.

The climax plant community is a mixture of grasses, trees, shrubs, and forbs. Forage production is high. The wide variety of plants attracts numerous deer, turkey, javelina, quail, dove, rabbits, squirrels, and predatory birds and animals. Proper management, such as controlled grazing, proper stocking, and brush management, can help maintain the high productivity.

Occasional flooding poses no problems on improved pasture; however it reduces yields on cropland. Forage production is high. Improved varieties of bermudagrass, bluestem, rhodesgrass, bahiagrass, and kleingrass are the main pasture grasses, and grain sorghum, cotton, and corn are the main cultivated crops. Fertilization, weed control, controlled grazing, proper stocking, and brush management help maintain high productivity. Cropping systems that include water management, fertilization, cover crops, conservation tillage, and residue management help to maintain fertility and productivity. Diversion terraces are needed in some areas to control the runoff from adjoining uplands. Levees are necessary in all areas to protect against occasional flooding by streams.

This soil is severely restricted for urban and some recreational uses because of occasional flooding. Playgrounds are moderately affected, but picnic areas and paths and trails are only slightly affected by flooding.

This Sinton soil is in capability subclass IIw and in the Loamy Bottomland range site.

St—Sinton clay loam, frequently flooded. This soil is deep, nearly level, and well drained. It is on flood plains. The surface is plane to slightly concave. Slopes are less than 1 percent, averaging about 0.5 percent. This soil is in long, narrow areas along rivers and creeks. Individual areas of this soil range from about 10 to 150 acres.

Typically, the surface layer is sandy clay loam 38 inches thick. It is dark gray in the upper part and dark grayish brown in the lower part. The underlying material to a depth of 60 inches is fine sandy loam. It is light brownish gray to a depth of 56 inches and light gray below that. It has a few thin lenses of clay and sand and a few films and threads of calcium carbonate. This soil is moderately alkaline throughout. Snail shells and shell fragments are throughout the profile.

This soil has very slow to slow surface runoff. Permeability is moderate, and the available water capacity is high. The root zone is deep. The soil is frequently flooded. It is inundated from several days to several weeks or more. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Edroy, and Odem soils. Also included are small areas of soils that have slopes of more than 1 percent, soils that are occasionally flooded, and soils that have less than 6 inches of clayey and sandy overwash on the surface. The included soils make up less than 15 percent of the map unit.

This Sinton soil is used almost exclusively as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture.

The climax plant community is a mixture of grasses, trees, shrubs, and forbs. Forage production is high, and a wide variety of plants are present. However, because of frequent flooding, few wildlife species inhabit areas of this soil. Proper management practices, such as controlled grazing, proper stocking, and brush management, can help maintain the high productivity.

Frequent flooding slightly reduces yields on improved pasture. Improved varieties of bermudagrass, bluestem, bahiagrass, and kleingrass are the main pasture grasses. Fertilization, controlled grazing, proper stocking, and brush management help maintain high productivity.

This soil is severely restricted for use as cropland and for urban and recreational uses because of frequent flooding.

This Sinton soil is in capability subclass Vw and in the Loamy Bottomland range site.

Va—Victine clay. This soil is deep, nearly level, and somewhat poorly drained. It is on low coastal terraces. The surface is plane. Slopes are 0 to 1 percent, averaging about 0.5 percent. In undisturbed areas, this soil has distinct gilgai microrelief. When dry, this soil has cracks up to 3 inches wide, which become narrower with depth. The cracks extend into the underlying material. Some areas of this soil are subject to rare flooding by high tides caused by storms. Periods of inundation are of short duration, usually a few hours to a day or two. Areas of this soil are large and irregularly shaped and range from about 10 to several hundred acres.

Typically, the surface layer is very dark gray, moderately alkaline clay 44 inches thick. It is very slightly saline in the upper part and slightly saline in the lower part. The surface layer has a few calcium carbonate concretions. The subsoil to a depth of 64 inches is strongly alkaline, moderately saline, gray clay. It has light

gray vertical streaks, few concretions of calcium carbonate, and a few gypsum crystals and other salts. The underlying material to a depth of 72 inches is strongly alkaline, moderately saline, light gray clay. It has a few gray vertical streaks, concretions of calcium carbonate, and gypsum crystals and other salts.

This soil has slow to very slow surface runoff. Permeability is very slow. The available water capacity is low because of salinity. Water enters the soil rapidly when the soil is dry and cracked and very slowly when it is moist. The root zone is deep, but clay content and salinity tend to impede the growth of roots. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Edroy, Monteola, Narta, Orelia, and Victoria soils. Also included are small areas of soils that have slopes of more than 1 percent, and soils that have a silty clay and clay loam surface layer. The included soils make up less than 10 percent of the map unit.

This Victine soil is used mainly as rangeland and habitat for wildlife.

The climax plant community is an open grassland dominated by salt-tolerant plants. Forage production is only fair because of salinity and droughtiness. Some areas are dominated by brush and other woody plants because of overgrazing. Because of the narrow range of plants, only a few deer, wild hogs, rabbits, and predatory animals inhabit areas of this soil. Proper management, such as controlled grazing, proper stocking, and brush management, can improve and help maintain productivity.

This soil is not recommended for use as improved pasture or cropland. Salinity, wetness, low available water capacity, and poor soil tilth severely reduce yields.

This soil is severely restricted for urban uses by very slow permeability, wetness, high shrink-swell potential, low strength, the clayey texture, and corrosiveness of uncoated steel. This soil is moderately restricted for recreational uses because of the clayey texture and very slow permeability.

This Victine soil is in capability subclass VIs and in the Salty Prairie range site.

VcA—Victoria clay, 0 to 1 percent slopes. This soil is deep, nearly level, and somewhat poorly drained. It is on uplands. The surface is plane. Slopes average about 0.2 percent. In undisturbed areas, this soil has distinct gilgai microrelief. When dry, it has cracks 0.4 inch to 3 inches wide at the surface. The cracks extend 3 to 6 feet into the soil (fig. 11). Individual areas of this soil are large and irregularly shaped and range from about 10 to 2,600 acres.

Typically, the surface layer is moderately alkaline clay 45 inches thick. It is very dark gray to a depth of 9 inches and black below that. The subsoil to a depth of 72 inches is moderately alkaline, light brownish gray clay. It has vertical dark gray streaks and a few concretions of calcium carbonate throughout. A few pockets and seams of gypsum crystals are in the lower part of the subsoil. The underlying material to a depth of 94 inches is moderately alkaline, light gray clay. It has a few gray streaks, concretions of calcium carbonate, and pockets and seams of gypsum crystals and other salts.

This soil has slow to very slow surface runoff. Permeability is very slow, and the available water capacity is high. Water enters the soil rapidly when the soil is dry and cracked and very slowly when the soil is moist and the cracks are sealed. The root zone is deep, but clay content tends to impede the movement of air, roots, and water. Water erosion is a slight hazard.

Included in mapping are small areas of Copano, Edroy, Faddin, Inez, Orelia, Papalote, Victine, and Vidauri soils. Also included are small areas of soils that have slopes of more than 1 percent, areas of soils in depressions, and small areas of soils that have a silty clay or clay loam surface layer. The included soils make up less than 15 percent of the map unit.

This Victoria soil is used mainly as rangeland and habitat for wildlife. In some areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid and tall grasses. Forage production is only fair because of wetness. Some areas are dominated by brush because of overgrazing. Some quail, dove, songbirds, rabbits, and predatory animals inhabit the areas of this soil. Controlled grazing, proper stocking, and brush management can improve and help maintain productivity.

This soil is limited for use as cropland and improved pasture because of poor soil tilth and wetness. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestem, kleingrass, rhodesgrass, and bahiagrass are the main pasture grasses. Cropping systems need to include water management. In most areas, simple drainage can remove excess water; however, in other areas, land leveling, land smoothing, or an installed drainage system are needed. Fertilization, conservation tillage, cover crops, and residue management improve and help maintain soil tilth, fertility, and productivity. Fertilization, weed control, controlled grazing, proper stocking, and brush management improve and help maintain pasture productivity.

This soil is severely restricted for most urban uses and moderately restricted for recreational uses. Very slow permeability affects septic tank systems. The clayey texture, high shrink-swell potential, and low strength are limitations for building foundations and for streets and roads. High corrosiveness of uncoated steel affects installation of public utilities. Recreational facilities are affected by the very slow permeability and clayey texture.

This Victoria soil is in capability subclass IIs and in the Blackland range site.

Figure 11.—Victoria clay, 0 to 1 percent slopes, has high shrink-swell potential. Deep, wide cracks develop in the soil when it dries.

VcB—Victoria clay, 1 to 3 percent slopes. This soil is deep, gently sloping, and somewhat poorly drained. It is on uplands. The surface is plane to slightly convex. In undisturbed areas, this soil has distinct gilgai microrelief, generally aligned with the slopes. Slopes average about 2 percent. Individual areas of this soil are mostly long and narrow along slope breaks and range from about 10 to 380 acres.

On a microhigh, the surface layer is moderately alkaline clay 22 inches thick. It is very dark gray in the upper part and gray in the lower part. A few calcium carbonate concretions are in this layer. The next layer to a depth of 36 inches is moderately alkaline, gray clay. Concretions of calcium carbonate, dark gray vertical streaks, and a few pockets and seams of gypsum crystals are in the lower part of this layer. The underlying material to a depth of 60 inches is moderately alkaline light gray clay. It has a few gray streaks, concretions of calcium carbonate, and pockets and seams of gypsum crystals and other salts. On the adjoining microlow, the surface layer is very dark gray clay to a depth of more than 40 inches.

This soil has slow to moderate surface runoff. Permeability is very slow, and the available water capacity is high. Water enters the soil rapidly when the soil is dry and cracked and very slowly when it is moist and the cracks are sealed. The root zone is deep, but clay content tends to impede the movement of air, roots, and water. Water erosion is a moderate hazard.

Included in mapping are small areas of Copano, Faddin, Monteola, Narta, Orelia, Papalote, Victine, and Vidauri soils. Also included are small areas of soils that have slopes of less than 1 percent, soils that have slopes of more than 3 percent, areas that have a few rills and shallow gullies, and small areas of soils that have a silty clay or clay loam surface layer. The included soils make up less than 15 percent of the map unit.

This Victoria soil is used mainly as rangeland and habitat for wildlife. In some areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid and tall grasses. Forage production is only fair because of water erosion. Some areas are dominated by brush because of overgrazing. Some quail,

dove, songbirds, rabbits, and predatory animals inhabit areas of this soil. Controlled grazing, proper stocking, and brush management can improve and help maintain productivity.

Poor soil tilth and water erosion reduce yields on cropland and improved pasture. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestems, kleingrass, rhodesgrass, and bahiagrass are the main pasture grasses. Cropping systems that include water management, fertilization, conservation tillage, cover crops, and residue management improve and help maintain soil tilth, fertility, and productivity. Contour farming and a properly installed terrace and waterway system help control surface runoff and reduce the hazard of water erosion. Diversion terraces are needed in some areas to control runoff. Fertilization, weed control, controlled grazing, and proper stocking help control surface runoff and erosion and improve and maintain productivity on pastures.

This soil is severely restricted for most urban uses and moderately restricted for recreational uses. Very slow permeability affects septic tank systems. High shrink-swell potential, the clayey texture, and low strength are limitations for building foundations and for streets and roads. Corrosiveness of uncoated steel affects installation of public utilities. The very slow permeability, clayey texture, and slope limit recreational uses.

This Victoria soil is in capability subclass IIIe and in the Blackland range site.

Vd—Victoria clay, depressional. This soil is deep, nearly level, and somewhat poorly drained. It is on uplands. The surface is slightly concave. This soil occurs as irregularly shaped areas within larger areas of Victoria clay, 0 to 1 percent slopes. The areas of Victoria clay, depressional, are 0.5 to 1 foot lower in elevation than the surrounding Victoria clay, 0 to 1 percent slopes. Slopes are less than 1 percent, averaging about 0.3 percent. Individual areas of this soil range from about 10 to 800 acres.

Typically, the surface layer is moderately alkaline clay 42 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The subsoil to a depth of 60 inches is moderately alkaline, gray clay. It has dark gray and very dark gray vertical streaks, a few calcium carbonate concretions, and a few pockets and seams of gypsum and other salts in the lower part. The underlying material to a depth of 72 inches is moderately alkaline, light gray clay. It has a few gray streaks, concretions of calcium carbonate, and pockets and seams of gypsum crystals and other salts.

This soil is ponded or has very slow surface runoff. Permeability is very slow and the available water capacity is high. Water enters the soil rapidly when the soil is dry and cracked and very slowly when it is moist and the cracks are sealed. The root zone is deep, but the clay content impedes the movement of air, roots, and water. Following rainfalls, this soil remains wet for periods of a few days to about a week longer than surrounding areas. Water erosion is a slight hazard.

Included in mapping are small areas of Aransas, Edroy, Narta, Orelia, Papalote, Victine, and Vidauri soils. Also included are small areas of Victoria soils that have slopes of more than 1 percent and areas that are not ponded. Small areas of soils that have a silty clay or clay loam surface layer are also included. The included soils make up less than 10 percent of the map unit.

This Victoria soil is used mostly as rangeland and habitat for wildlife. In some areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid and tall grasses. Forage production is only fair because of ponding of water and wetness of the soil. Some areas have a large population of water-tolerant species, and other areas are dominated by woody plants because of wetness and overgrazing. Some quail, dove, songbirds, rabbits, predators, and a few waterfowl inhabit areas of this soil. Proper management, such as controlled grazing, proper stocking, and brush management, can improve and help maintain productivity.

Wetness, ponding of water, and poor soil tilth reduce yields on cropland and improved pasture (fig. 12). Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestem, kleingrass, rhodesgrass, and bahiagrass are the main pasture grasses. Cropping systems need to include water management. In some areas, simple drainage practices can remove excess water; however, in other areas, land leveling, land smoothing, or an installed drainage system is needed. Fertilization, conservation tillage, cover crops, and residue management improve and help maintain soil tilth, fertility, and productivity. Fertilization, weed control, controlled grazing, proper stocking, and brush management improve and help maintain pasture productivity.

This soil is severely restricted for urban and recreational uses. Ponding of water and the very slow permeability affect septic tank systems. Ponding, high shrink-swell potential, and low strength are limitations for building foundations and for streets and roads. High corrosiveness of uncoated steel limits installation of public utilities. Ponding of water limits recreational uses of this soil.

This Victoria soil is in capability subclass IIw and in the Blackland range site.

Vr—Vidauri fine sandy loam. This soil is deep, nearly level, and poorly drained. It is on uplands. The surface is plane to slightly concave. Slopes are less than 1 percent, averaging about 0.5 percent. Individual areas are irregularly shaped and range from about 10 to several hundred acres.

Figure 12.—Victoria clay, depressional, is ponded following a period of heavy rainfall.

Typically, the surface layer is slightly acid, light brownish gray fine sandy loam 6 inches thick. The subsoil extends to a depth of at least 66 inches. To a depth of 21 inches, it is clay. It is grayish brown and slightly acid in the upper part and light brownish gray and neutral in the lower part. To a depth of 31 inches, the subsoil is moderately alkaline, light brownish gray sandy clay, and below that, it is moderately alkaline, very pale brown sandy clay loam. The subsoil has mottles in shades of yellow and brown throughout.

This soil has very slow surface runoff or is ponded. Permeability is very slow, and the available water capacity is high. The root zone is deep, but the clay content impedes movement of air, water, and roots. Water ponds on the surface for periods of several days to several weeks following heavy rainfall. This soil is saturated to the surface for long periods during spring, fall, and winter of most years. Water erosion is a slight hazard.

Included in mapping are small areas of Copano, Edroy, Faddin, Inez, Narta, Orelia, Papalote, Victoria, and Wyick soils. Also included are small areas of soils that have slopes of more than 1 percent and soils that have a loamy fine sand surface layer. The included soils make up less than 15 percent of the map unit.

This Vidauri soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as cropland or improved pasture.

The climax plant community is an open grassland dominated by mid grasses with an occasional shrub or tree. Forage production is only fair because of wetness and ponding of water. Some areas are in poor condition because of overgrazing. Some deer, quail, dove, rabbits, predators, and wetland species inhabit these areas. Proper management, such as controlled grazing and proper stocking, can improve and help maintain productivity.

Wetness and ponding of water reduce yields on cropland and improved pasture. Grain sorghum, cotton, and corn are the major cultivated crops, and improved varieties of bermudagrass, bluestem, kleingrass, rhodesgrass, and bahiagrass are the main pasture grasses. Cropping systems that include water management, fertilization, cover crops, conservation

tillage, and residue management improve and help maintain soil tilth and productivity. In some areas, simple drainage practices can remove excess water; however, in other areas, land leveling, land smoothing, or an installed drainage system are needed. Fertilization, weed control, proper stocking, and controlled grazing improve and help maintain pasture productivity.

This soil is severely restricted for urban and recreational uses. Ponding of water and very slow permeability affect septic tank systems. Ponding, shrinking and swelling, and low strength are limitations for building foundations and for streets and roads. Corrosiveness of uncoated steel affects installation of public utilities. Ponding also restricts recreational uses.

This Vidauri soil is in capability subclass IIIw and in the Claypan Prairie range site.

Wy—Wyick fine sandy loam. This soil is moderately deep, nearly level, and somewhat poorly drained. It is on uplands. The surface is plane. Slopes range from 0 to 2 percent, averaging about 0.5 percent. Individual areas of this soil are irregularly shaped and range from about 10 to 250 acres.

Typically, the surface layer is slightly acid, light brownish gray fine sandy loam 10 inches thick. The subsoil extends to a depth of 38 inches. To a depth of 21 inches, it is slightly acid, light brownish gray clay that has distinct yellowish brown mottles and a few faint gray mottles. To a depth of 32 inches, the subsoil is moderately alkaline, light gray clay loam that has distinct yellowish brown mottles and a few faint gray mottles. Below that, the subsoil is moderately alkaline, very pale brown sandy clay loam that has a few fine concretions and soft powdery forms of calcium carbonate. The underlying material to a depth of 60 inches is moderately alkaline, light gray sandy clay loam that has about 5 percent, by volume, fine concretions and soft powdery forms of calcium carbonate.

This soil has very slow surface runoff, or it is ponded. Permeability is very slow, and the available water capacity is moderate. The root zone is moderately deep, but the blocky structure of the subsoil tends to impede the movement of air, roots, and water. Water erosion is a slight hazard. A perched high water table is between the surface and a depth of 12 inches for long periods in fall, winter, and spring of most years.

A few areas of Wyick soils have small, sandy mounds, known locally as pimple mounds. These mounds have a loamy fine sand surface layer that is 20 inches or more thick and have lower horizons similar to those of the Wyick soil. The mounds are generally round or oval. They range from 20 to 150 feet in diameter, averaging about 55 feet. The mounds are 1 foot to 2.5 feet higher than the surrounding area, and they make up about 15 percent of the delineations where they occur.

Included in mapping are small areas of Edroy, Faddin, Inez, Orelia, Papalote, Victoria, and Vidauri soils. Also included are small areas of soils that have slopes of more than 2 percent and soils that have a loamy fine sand surface layer. The included soils make up less than 20 percent of the map unit.

This soil is used mainly as rangeland and habitat for wildlife. In a few areas, it is used as improved pasture.

The climax plant community is an open grassland dominated by mid and tall grasses. Forage production is only fair because of wetness and ponding of water. Some areas are in poor condition because of overgrazing. Numerous quail, dove, rabbits, songbirds, predators, and some deer and wetland species inhabit the areas of this soil. Proper management, such as controlled grazing and proper stocking, can improve and help maintain productivity.

Wetness and ponding of water reduce yields on improved pasture. Improved varieties of bermudagrass, kleingrass, rhodesgrass, and bahiagrass are the main pasture grasses. Fertilization, weed control, proper stocking, and controlled grazing improve and help maintain pasture productivity.

This soil is severely restricted for use as cropland and for urban and recreational uses. Ponding of water and wetness of the soil severely reduce yields on cropland. Urban and recreational uses are restricted by ponding, very slow permeability, shrinking and swelling, low strength, and corrosiveness of uncoated steel.

This Wyick soil is in capability subclass IIIw and in the Loamy Prairie range site.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Refugio County are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 5 percent.

About 290,000 acres, or nearly 56 percent of Refugio County, is prime farmland. The prime farmland is scattered throughout the county, but the largest areas are in general soil map units 1 and 2. Substantial areas are in map units 3 and 4, and only scattered areas are in map units 5 and 6. About 60,000 acres of the prime farmland is used for cultivated crops. The crops, mainly grain sorghum, cotton, and corn, account for an estimated 60 percent of the county's total agricultural income each year.

A recent trend in land use in some parts of Refugio County has resulted in the loss of some prime farmland to urban and industrial uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, difficult to cultivate, and less productive than prime farmland.

The following map units, or soils, make up prime farmland in Refugio County. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Soils that have limitations, such as a high water table or flooding, may qualify as prime farmland if these limitations are overcome by such measures as drainage or flood control. In the following list, the measures needed to overcome the limitations of a map unit, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to determine if the limitations have been overcome by the corrective measures.

Fd	Faddin fine sandy loam
MoC	Monteola clay, 3 to 5 percent slopes
Od	Odem fine sandy loam, occasionally flooded
PaB	Papalote loamy fine sand, 0 to 3 percent slopes
PtA	Papalote fine sandy loam, 0 to 1 percent slopes
PtB	Papalote fine sandy loam, 1 to 3 percent slopes
PtC	Papalote fine sandy loam, 3 to 5 percent slopes
Sn	Sinton clay loam, occasionally flooded
VcA	Victoria clay, 0 to 1 percent slopes
VcB	Victoria clay, 1 to 3 percent slopes
Vd	Victoria clay, depressional (where drained)

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Carroll R. Wilson, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Crops

In 1967, about 94,000 acres in Refugio County was used as cropland *(14)*. Of this, 73,500 acres was used for row crops, mainly grain sorghum, cotton, and corn; 4,000 acres was used for close growing crops, mainly wheat, flax, and oats; and 4,700 acres was in other small grains, forage sorghum, and improved species of grasses used for hay and pasture. The rest was in idle cropland and summer fallow.

Land use in the county has recently started changing at a more rapid rate than in the past. Rangeland is being converted to cropland, and some cropland has been converted to pastureland. Rangeland, cropland, and pastureland acreage has gradually been decreasing as more land is being used for urban and built-up areas and subdivisions. This soil survey can provide useful information to help make land use decisions.

The potential for increased production is high on Refugio County soils. About 3,800 acres of potentially good or fair cropland is currently being used as pasture and hayland, and about 381,000 acres is used as rangeland. Most of this land would require drainage, land leveling or smoothing, or erosion control practices for sustained economical crop production. Crop production could also be increased by extending the use of the latest technology and methods to all cropland in the county.

Soil drainage is the major concern on about 92 percent of the cropland, pastureland, and hayland in the county. Surface runoff is ponded, very slow, or slow on most of the soils. The nearly level, poorly drained Aransas, Copano, Edroy, and Vidauri soils and the nearly level, somewhat poorly drained Faddin, Inez, Orelia, Victoria, and Wyick soils need artificial drainage to remove excess water during wet periods. The design of drainage systems varies with the kind of soil. Drains have to be more closely spaced in very slowly or slowly permeable soils than in more permeable soils.

Soil erosion is a concern on only about 8 percent of the cropland, pastureland, and hayland in the county. If the slope is more than 1 percent, erosion is a potential hazard. The Monteola soil and some Papalote and Victoria soils have slopes of more than 1 percent.

Erosion of the surface layer results in reduced productivity. Loss of the surface layer is especially damaging to soils that have a clayey subsoil, such as Papalote soils. A part of the clayey, less fertile subsoil is incorporated into the plow layer. This contributes to reduced productivity. Erosion also reduces productivity on soils that tend to be droughty, such as Papalote soils.

Soil erosion also results in the pollution and sedimentation of streams, ponds, lakes, bays, and estuaries. Controlling erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, recreation, and for fish and wildlife.

Erosion control practices that provide a protective cover on the surface reduce runoff and increase infiltration. On sloping cropland, a cropping system that keeps a vegetative cover on the soil can hold soil erosion losses to amounts that will not reduce productivity.

Reduced tillage and crop residue left on the surface help increase infiltration and reduce the hazards of runoff and erosion. These practices can be used on most soils in the county, but more especially on soils that have slopes so short and irregular that contour tillage and terraces are not practical. Reduced tillage and crop residue management are more difficult to use successfully on eroded soils and on soils that have a clayey surface layer, such as Monteola and Victoria soils.

Terraces and diversions reduce the length of slope and help control runoff and erosion. Because of short periods of heavy rainfall, terraces are necessary to carry the excess water to a safe outlet. Monteola, Papalote, and Victoria soils are suitable for terraces.

Contour tillage is used in the county to control erosion and runoff. It is best suited to soils that have smooth, uniform slopes, such as Papalote and Victoria soils.

Soil blowing is a hazard on the sandy Dietrich, Falfurrias, Galveston, Mustang, Papalote, and Sarita soils. It can damage these soils in a few hours if the winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining a surface cover minimizes soil blowing.

Natural fertility is high in most of the soils that formed on flood plains, such as Aransas, Odem, and Sinton soils. These soils are higher in plant nutrients than most soils on uplands.

The soils on uplands that formed under prairie vegetation are generally moderately high to high in plant nutrients. These soils mostly have a dark color, loamy to clayey surface layer that ranges from slightly acid to moderately alkaline. The clayey soils generally have medium to high levels of phosphorus and potassium; the loamy soils have low to medium levels.

The soils on uplands that formed under woody vegetation are generally moderately low to medium in plant nutrients. These soils mostly have a light color, loamy to sandy surface layer that ranges from medium acid to neutral. The loamy soils generally have moderately low to medium levels of phosphorus and potassium; the sandy soils have low levels.

Nitrogen and phosphorus are needed for most crops and improved pasture grasses. Although some of the soils are acid, lime generally is not needed because sufficient calcium is normally available in the soil. Fertilizer requirements should be based on the needs of the soil and the expected yield. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Tilth is a concern on the dark, clayey Aransas, Edroy, Monteola, and Victoria soils because they often stay wet until late in spring. If they are wet when plowed, they tend to be very cloddy when dry, and a good seedbed is difficult to prepare.

Tilth is also a concern on the dark, loamy Copano, Orelia, Vidauri, and Wyick soils. Generally these soils have weak structure and are hard and massive when dry. They tend to form a hard surface crust that is nearly impervious to water when dry. Surface crusting reduces infiltration and increases runoff. Crop residue left at the surface can improve soil structure and reduce crusting. Fall plowing generally results in good tilth in the spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Grain sorghum, cotton, and corn are the principal row crops. Sunflowers, soybeans, rice, and similar crops can be grown. Small acreages of flax, wheat, oats, and forage sorghum are grown in most years.

Speciality crops are not grown commercially in the county; however, large areas of the soils in the county are suited to a wide variety of fruits, vegetables, and other speciality crops.

Pasture

Pastureland and hayland make up only about 1 percent, or 4,700 acres, of the county *(14)*. Improved pasture is normally planted to introduced species of perennial grasses and used for hay and forage production.

The more important grasses are coastal bermudagrass, kleingrass, bahiagrass, rhodesgrass, johnsongrass, and improved species of bluestem. The grass is grazed by domestic animals or mechanically harvested. In a few areas, the soils are planted to annual hybrids and used for supplemental summer grazing or cut and baled for hay (fig. 13).

Figure 13.—Hayland is an important part of most ranching operations. This hay on Victoria clay, 0 to 1 percent slopes, is baled for winter use.

Management concerns on pastureland are fertilization, proper stocking, controlled grazing, and weed control. Fertilizer should be applied according to the kind of soil, plant needs, desired production level, and soil tests. Pastureland needs to be stocked according to the amount of forage available and grazed only to a height that permits plants to remain healthy and vigorous. Well managed stands of grasses tend to eliminate most weeds; but in areas needing it, weed control can be accomplished by mowing or shredding, or by applying herbicides.

Management concerns on hayland are fertilization, timely mowing, and weed control. The kind of soil, plant needs, desired production level, and soil tests determine the rate of fertilization. Timely mowing ensures high quality, maximum production, and plant vigor. Hay needs to be cut to a height that is best for the plant. Mowing too close or too often damages the grasses as much as overgrazing damages pastureland or rangeland. Mowing at the proper height helps to maintain plant vigor and leaves residue on the surface to help control erosion, reduce runoff, and maintain organic matter content. Weeds can be controlled by mowing or shredding, or by applying herbicides.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the

Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use. There are not any Class I soils in Refugio County.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode, but they have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

The soils in class V are subject to little or no erosion, but they have other limitations that restrict their use to pasture, rangeland, wildlife habitat, or recreation. Class V contains only the subclasses indicated by *w, s,* or *c*.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Mike Black and Kenneth Smith, range conservationists, Soil Conservation Service, helped plan and write this section.

Rangeland is defined as land on which native vegetation consists of a wide variety of grasses, grass-like plants, forbs, shrubs, and trees. The vegetation generally is suitable for grazing by domestic livestock and native wildlife. This native grassland receives no regular or frequent cultural treatment. The composition and production of the plant community on rangeland is determined by soil, climate, topography, overstory canopy, and grazing management.

About 77 percent, or 381,000 acres, of the county is rangeland *(14)*. Most of the rangeland has traditionally been in a few large ranches. In the past few years, the number of smaller ranches engaged in livestock enterprises has increased. With few exceptions, the rangeland is used for cow-calf production. Some horses are raised for ranch work on the larger operations.

The plant communities of Refugio County have changed drastically over the past 100 years. Originally, most of the county was an open, treeless prairie. This prairie consisted of a wide variety of mid and tall grasses interspersed with an abundance of forbs. Continuous heavy grazing for many years resulted in a deteriorated and depleted plant community. Much of the high-producing, high-quality vegetation has been grazed out. These higher quality plants are now less abundant. The better plants have been replaced by a mixture of lower quality grasses, forbs, and brush. Where remnants of the better plants occur, good grazing management allows these plants to reestablish themselves.

Because about 30 percent of annual rainfall occurs in April, May and June, about 50 percent of the annual growth of warm-season plants is produced during this period. A mid-summer growth slump occurs in July and August. A secondary growth period occurs in September, October, and early in November when fall rains and somewhat cooler temperatures are common. However, this production period is limited by the increasingly cooler temperatures and shorter days.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship of the soils, vegetation, and water.

Table 6 shows for each soil the range site and the total annual production of vegetation in favorable, normal, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a natural plant community that differs from other natural plant communities on other range sites in kind, amount, or proportion of range plants. Range sites were correlated to appropriate soils during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is in good to excellent condition. Total production includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of grasses, forbs, and woody plants. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation.

Range management requires a knowledge of the kinds of soil and of the climax plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential climax plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the range site is maintained or improved to excellent condition. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Range Sites and Condition Classes

Soils that produce about the same kinds and amounts of climax vegetation for forage make up a range site. Soil properties that affect moisture supply and plant nutrients have the most influence on productivity.

The climax vegetation on a range site is the stabilized plant community that reproduces and maintains itself with very little change as long as environmental conditions do not change. The climax vegetation is generally made up of a high number of productive palatable plants.

Decreasers are plants in the climax vegetation that tend to decrease in the plant community with continuous heavy grazing. They generally are the most productive perennial grasses and forbs and are highly preferred by livestock.

Increasers are plants in the climax vegetation that increase in the plant community as the more desirable decreasers are reduced by close grazing. They are commonly shorter and produce less forage than decreasers and are generally less palatable to livestock.

Invaders are plants that are not a part of the climax vegetation. These plants come in after the climax vegetation has been reduced by continued close grazing. Invaders compete for moisture, plant nutrients, and light and may become prominent and persistent.

Range condition is determined by comparing existing plant communities with the climax plant community for a specific range site. This departure from climax is broken into four condition classes. The four classes are used to indicate the degree of departure from the potential, or climax, vegetation. They show the present condition of the native plant community as compared to the climax plant community. Range in excellent condition has 76 to 100 percent of the same kind of vegetation as the climax stand; good condition, 51 to 75 percent; fair condition, 26 to 50 percent; and poor condition, 25 percent or less.

The 17 range sites in Refugio County are Blackland, Clayey Bottomland, Claypan Prairie, Coastal Sand, Lakebed, Loamy Bottomland, Loamy Prairie, Loamy Sand, Low Coastal Sand, Rolling Blackland, Salty Bottomland, Salty Prairie, Sandy, Sandy Coastal Flat, Sandy Hill, Sandy Loam, and Tight Sandy Loam.

Blackland range site. The Victoria soils (map units VcA, VcB, and Vd) are in this site. The climax vegetation is open grassland dominated by mid and tall grasses (fig. 14). The composition, by weight, is about 95 percent grasses and 5 percent forbs.

About 80 percent of the climax vegetation is made up of little bluestem, indiangrass, sideoats grama, and vine mesquite. Other grasses are longtom, brownseed paspalum, Texas wintergrass, Nash windmillgrass, plains bristlegrass, curlymesquite, and buffalograss. Forbs include sensitivebrier, bundleflower, snoutbean, dotted gayfeather, Maximilian sunflower, and yellow neptunia.

If retrogression occurs as a result of heavy grazing, little bluestem, indiangrass, and Maximilian sunflower are replaced by Texas wintergrass, brownseed paspalum, and dropseed. If close grazing continues over a long period, such woody plants as agarita, lotebush, spiny hackberry, huisache, and mesquite increase significantly

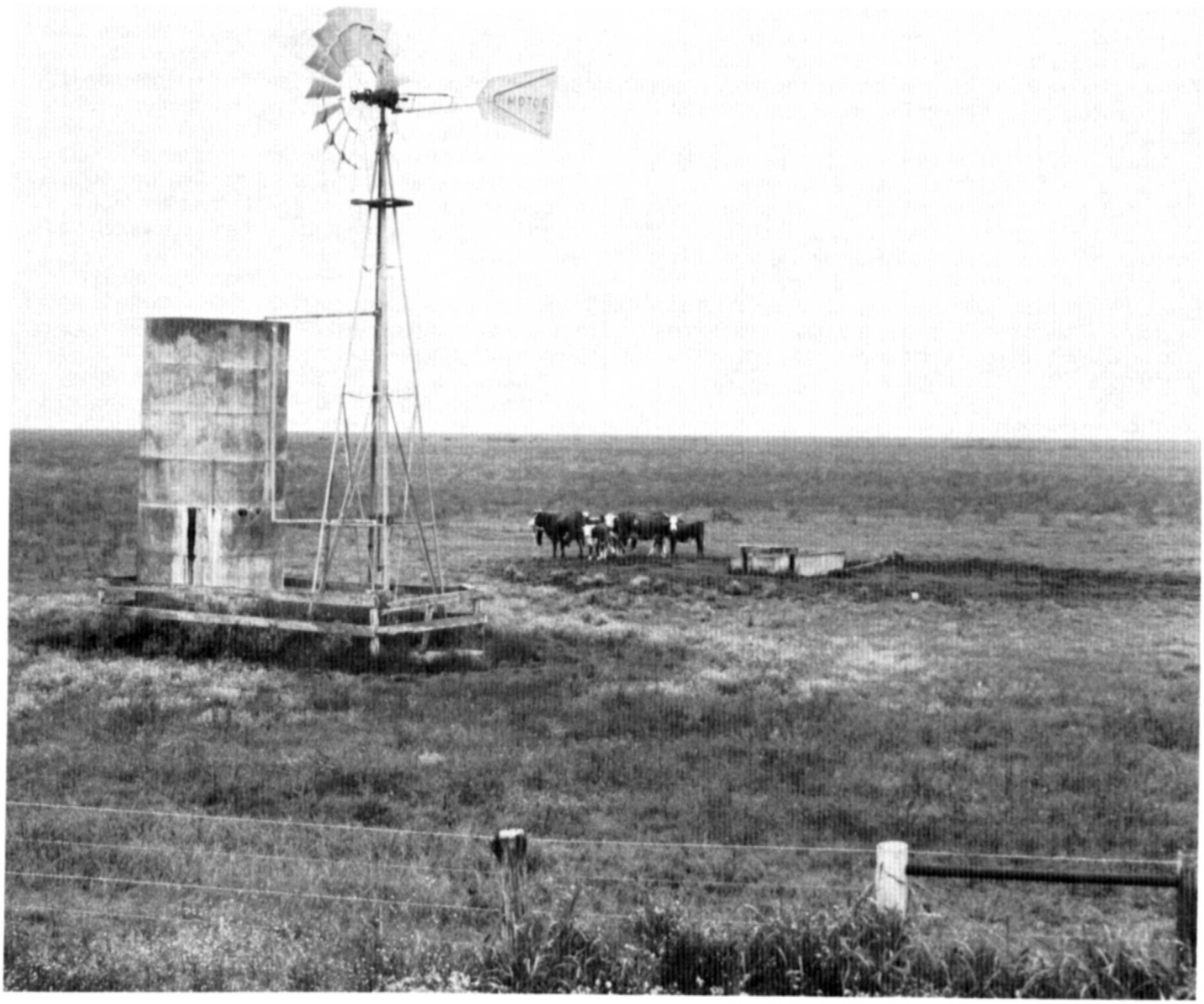


Figure 14.—This area of Victoria clay, 0 to 1 percent slopes, is in the Blackland range site along the Texas Gulf Coast. This range site is dominantly mid and tall grasses.

with an understory of threeawns, ragweed, smutgrass, tumble windmillgrass, and frogfruit.

Clayey Bottomland range site. The Aransas soils (map units Ac and Af) are in this site (fig. 15). The climax vegetation is a savannah of mixed grasses with an occasional motte of trees and shrubs. The composition, by weight, is about 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

About 65 percent of the climax vegetation is made up of little bluestem, indiangrass, switchgrass, Virginia wildrye, big bluestem, and vine mesquite. Other grasses are longtom, brownseed paspalum, bristlegrass, buffalograss, curlymesquite, common bermudagrass, and low panicums. Woody plants include oak, elm, pecan, willow, cottonwood, hackberry, anaqua, and woody vines. Forbs include Engelmann daisy, sensitivebrier, bundleflower, snoutbean, and annuals.

Figure 15.—The Clayey Bottomland range site is mainly mixed grasses. The soil in this area is Aransas clay, frequently flooded.

If retrogression occurs as a result of heavy grazing, little bluestem, indiangrass, switchgrass, and big bluestem are replaced by Texas wintergrass, common bermudagrass, knotroot bristlegrass, low panicums and paspalums, and spiny aster. If close grazing continues over a long period, woody plants and trees form a dense stand with an understory of threeawns, bushy bluestem, smutgrass, bitter sneezeweed, and carpetgrass.

Claypan Prairie range site. The Edroy, Orelia, and Vidauri soils (map units Ec, Or, and Vr) are in this site. The climax vegetation is open grassland dominated by mid grasses with an occasional shrub or tree. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

About 60 percent of the climax vegetation is made up of little bluestem, sideoats grama, vine mesquite, and bristlegrass. Other grasses are longtom, brownseed paspalum, knotroot bristlegrass, windmillgrass, dropseeds, and Texas wintergrass. Forbs include bundleflower, sensitivebrier, snoutbean, Engelmann daisy, and annual forbs. Woody plants include huisache, spiny hackberry, lotebush, and kidneywood.

If retrogression occurs as a result of heavy grazing, little bluestem, sideoats grama, vine mesquite, and plains bristlegrass are replaced by Texas bristlegrass, knotroot bristlegrass, windmillgrass, and fall witchgrass. If close grazing continues over a long period, threeawns, red lovegrass, red grama, tumblegrass, tumble windmillgrass, dropseeds, and smutgrass dominate the site. Forbs, such as bitter sneezeweed, frogfruit, and ragweed, increase significantly.

Coastal Sand range site. The Galveston soil (map unit GmB) is in this site. The climax vegetation is open grassland dominated by tall grasses with scattered shrubs. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

About 80 percent of the climax vegetation is made up of little bluestem, seacoast bluestem, indiangrass, crinkleawn, switchgrass, gulfdune paspalum, and big bluestem. Other grasses include marshhay cordgrass, brownseed paspalum, longtom, gulfhairawn muhly,

dropseeds, low panicums, and sedges. Woody plants are dwarf liveoak, sweetbay, greenbrier, bigleaf sumpweed, and sesbania species. Forbs include snoutbean, western indigo, partridge pea, and annual forbs.

If retrogression occurs as a result of heavy grazing, little bluestem, seacoast bluestem, indiangrass, crinkleawn, and big bluestem are replaced by gulfdune paspalum, gulfhairawn muhly, threeawns, brownseed paspalum, bristlegrass, and sedges. If close grazing continues over a long period, ragweed, broomweed, and threeawns increase significantly. In some areas, dwarf liveoak increases to form a low, dense canopy that excludes all other vegetation.

Lakebed range site. The Edroy soil (map unit Ed) is in this site. The climax vegetation is open grassland that has varying degrees of wetness. The grassland is dominated by mid and short grasses with a few scattered woody plants. The composition, by weight, is about 95 percent grasses and 5 percent forbs and grass-like vegetation.

About 75 percent of the climax vegetation is made up of vine mesquite, Hartweg paspalum, spike lovegrass, switchgrass, and white tridens. Other grasses include buffalograss, common bermudagrass, knotroot bristlegrass, windmillgrass, and creeping lovegrass. The forbs are mainly annuals. The grass-like vegetation includes sedges, reeds, and rushes. Woody plants include sesbania, huisache, mesquite, and retama.

If retrogression occurs as a result of heavy grazing, vine mesquite, switchgrass, Hartweg paspalum, spike lovegrass, and white tridens are replaced by common bermudagrass, buffalograss, knotroot bristlegrass, and threeawns. If close grazing continues over a long period, sesbania, huisache, mesquite, and retama increase to form dense stands with an understory of threeawns, broomweed, and ragweed. In some areas, sedges, reeds, and rushes dominate.

Loamy Bottomland range site. The Odem and Sinton soils (map units Od, Sn, and St) are in this site. The climax vegetation is a mixture of grasses, trees, shrubs, and forbs. The composition, by weight, is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

About 65 percent of the climax vegetation is made up of little bluestem, seacoast bluestem, big bluestem, eastern gamagrass, switchgrass, big cenchrus, vine mesquite, and bristlegrass. Other grasses include Texas wintergrass, Virginia wildrye, white tridens, sideoats grama, buffalograss, curlymesquite, and common bermudagrass. Woody plants include elm, willow, pecan, hackberry, oak, woody vines, and bullnettle. Forbs include bundleflower, sensitivebrier, dayflower, partridge pea, Engelmann daisy, yellow neptunia, and croton.

If retrogression occurs as a result of heavy grazing, little bluestem, seacoast bluestem, big bluestem, eastern gamagrass, switchgrass, and big cenchrus are replaced by knotroot bristlegrass, common bermudagrass, windmillgrass, fall witchgrass, and dropseeds. If close grazing continues over a long period, threeawns, tumble windmillgrass, smutgrass, fringed signalgrass, and red grama increase significantly. Woody species, such as huisache, mesquite, and bullnettle, also increase.

Loamy Prairie range site. The Faddin and Wyick soils (map units Fd and Wy) are in this site. The climax vegetation is open grassland dominated by mid and tall grasses. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

About 60 percent of the climax vegetation is little bluestem. Other grasses include indiangrass, big bluestem, switchgrass, Virginia wildrye, brownseed paspalum, longtom, Florida paspalum, and fringeleaf paspalum. Forbs include bundleflower, sensitivebrier, snoutbean, partridge pea, dotted gayfeather, yellow neptunia, and Maximilian sunflower.

If retrogression occurs as a result of heavy grazing, little bluestem, indiangrass, big bluestem, switchgrass, Virginia wildrye, and Florida paspalum are replaced by brownseed paspalum, longtom, knotroot bristlegrass, and low panicums. If close grazing continues over a long period, threeawns, smutgrass, carpetgrass, bushy bluestem, red lovegrass, windmillgrass, bitter sneezeweed, and broomweed increase significantly.

Loamy Sand range site. The Papalote soil (map unit PaB) is in this site. The climax vegetation is open grassland dominated by mid and tall grasses with a few scattered trees and shrubs. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

About 75 percent of the climax vegetation is made up of little bluestem, seacoast bluestem, crinkleawn, switchgrass, tanglehead, brownseed paspalum, longtom, and bristlegrass. Other grasses include sideoats grama, knotroot panicum, silver bluestem, windmillgrass, and perennial threeawn. Forbs include snoutbean, partridge pea, dotted gayfeather, sensitivebrier, western indigo, Engelmann daisy, dayflower, and crotons. Woody plants are live oak, post oak, mesquite, huisache, pricklypear, lantana, hackberry, tasajillo, and spiny hackberry.

If retrogression occurs as a result of heavy grazing, little bluestem, seacoast bluestem, crinkleawn, switchgrass, and tanglehead are replaced by fall witchgrass, silver bluestem, windmillgrass, knotroot bristlegrass, and balsamscale. If close grazing continues over a long period, annual forbs, threeawns, signalgrass, sandbur, hairy grama, and red lovegrass increase significantly.

Low Coastal Sand range site. The Mustang soil (map unit GmB) is in this site. The climax vegetation is open, wet grassland of mixed grasses with a few

scattered woody plants, a few forbs, and some reeds, sedges, and rushes. Most of the plants are water tolerant. The climax plant community varies with the frequency of flooding, depth of water coverage, duration of coverage, salinity, and depth to permanent water table. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

About 80 percent of the climax vegetation is made up of marshhay cordgrass, seashore saltgrass, seacoast bluestem, seashore dropseed, switchgrass, and gulfdune paspalum. Other grasses include shoregrass, low panicums, and knotroot bristlegrass. Forbs include annual forbs, sea-lavender, and glasswort. Woody plants are bushy sea-oxeye and sesbania. Some areas have reeds, sedges, and rushes.

If retrogression occurs as a result of heavy grazing, marshhay cordgrass, seashore saltgrass, seacoast bluestem, seashore dropseed, and switchgrass are replaced by gulfdune paspalum, low panicums, and broomsedge bluestem. If close grazing continues over a long period, bushy sea-oxeye, sesbania, sedges, reeds, and rushes increase significantly.

Rolling Blackland range site. The Monteola soils (map units MoC and MoD4) are in this site. The climax vegetation is open grassland dominated by mid and short grasses with a few scattered woody plants. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

About 60 percent of the climax vegetation is made up of sideoats grama, vine mesquite, Texas cupgrass, little bluestem, and bristlegrass. Other grasses include buffalograss, curly mesquite, Texas wintergrass, silver bluestem, and lovegrass tridens. Forbs include snoutbean, bundleflower, sensitivebrier, dotted gayfeather, Maximilian sunflower, yellow neptunia, and annual forbs. Woody plants are spiny hackberry, acacia species, whitebrush, mesquite, pricklypear, and agarita.

If retrogression occurs as a result of heavy grazing, little bluestem, sideoats grama, vine mesquite, and Texas cupgrass are replaced by buffalograss, curly mesquite, Texas wintergrass, silver bluestem, and bristlegrass. If close grazing continues over a long period, red grama, threeawns, tumble windmillgrass, Texas grama, and prairie coneflower increase significantly. In badly deteriorated condition, woody plants dominate the site.

Salty Bottomland range site. The Aransas soil (map unit As) is in this site. The climax vegetation is open grassland dominated by salt- and water-tolerant plants. The composition, by weight, is about 85 percent grasses, 5 percent forbs, 5 percent woody plants, and 5 percent sedges, rushes, and reeds.

About 75 percent of the climax vegetation is made up of gulf cordgrass and marshhay cordgrass. Other grasses are smooth cordgrass, seashore saltgrass, shoregrass, seashore paspalum, seashore dropseed, common reed, and bulrushes. Forbs include glasswort, sea-lavender, and buckwheat. Woody plants are bushy sea-oxeye, slim aster, spiny aster, sumpweed, sesbania, and alligatorweed.

If retrogression occurs as a result of heavy grazing, marshhay cordgrass, smooth cordgrass, seashore saltgrass, common reed, seashore dropseed, and seashore paspalum are replaced by gulf cordgrass, shoregrass, bushy sea-oxeye, spiny aster, and sesbania. If close grazing continues over a long period, shoregrass, bushy sea-oxeye, sumpweed, alligatorweed, glasswort, and rushes and sedges increase significantly.

Salty Prairie range site. The Narta and Victine soils (map units Na and Va) are in this site (fig. 16). The climax vegetation is open grassland dominated by salt-tolerant plants. The composition, by weight, is about 95 percent grasses, 3 percent woody plants, and 2 percent forbs.

About 70 percent of the climax vegetation is gulf cordgrass. Other grasses are marshhay cordgrass, seashore saltgrass, little bluestem, switchgrass, vine mesquite, buffalograss, curlymesquite, common bermudagrass, longtom, brownseed paspalum, and knotroot bristlegrass. Woody plants are mesquite, pricklypear, spiny aster, bushy sea-oxeye, and woody glasswort. Forbs include annual forbs, glasswort, buckwheat, sea-lavender, and slim aster.

If retrogression occurs as a result of heavy grazing, little bluestem, switchgrass, vine mesquite, longtom, and brownseed paspalum are replaced by gulf cordgrass, common bermudagrass, red lovegrass, bitter sneezeweed, and bushy sea-oxeye. If close grazing continues over a long period, shoregrass, glasswort, bushy sea-oxeye, and sumpweed increase significantly.

Sandy range site. The Sarita soil (map unit SfC) is in this site. The climax vegetation is open grassland dominated by tall and mid grasses with an occasional tree. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

About 75 percent of the climax vegetation is made up of little bluestem, seacoast bluestem, indiangrass, switchgrass, tanglehead, fringeleaf paspalum, gulfdune paspalum, and crinkleawn. Other grasses are balsamscale, windmillgrass, threeawns, dropseeds, and witchgrass. Forbs include partridge pea, snoutbean, western indigo, sensitivebrier, dotted gayfeather, bullnettle, lantana, croton, and annuals. Woody plants are live oak, pricklypear, and mesquite.

If retrogression occurs, as a result of heavy grazing, little bluestem, seacoast bluestem, indiangrass, switchgrass, tanglehead, crinkleawn, and gulfdune paspalum are replaced by balsamscale, bristlegrass, windmillgrass, threeawns, and dropseeds. If close grazing continues over a long period, red lovegrass,

Figure 16—This area of the Salty Prairie range site has a vigorous stand of salt-tolerant gulf cordgrass on Victine clay.

sandbur, croton, beebalm, and tumble lovegrass increase significantly.

Sandy Coastal Flat range site. The Dietrich soil (map unit Dt) is in this site. The climax vegetation is open grassland dominated by tall grasses that are salt tolerant. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

About 65 percent of the climax vegetation is made up of little bluestem, seacoast bluestem, big sacaton, trichloris, spike lovegrass, knotroot bristlegrass, Hartweg paspalum, marshhay cordgrass, and gulf cordgrass. Other grasses are bushy bluestem, silver bluestem, shoregrass, windmillgrass, dropseeds, buffalograss, curlymesquite, and common bermudagrass. Forbs include sensitivebrier, snoutbean, bundleflower, western indigo, ragweed, orange zexmenia, and annuals. Woody plants are live oak, mesquite, spiny hackberry, and pricklypear.

If retrogression occurs as a result of heavy grazing, little bluestem, seacoast bluestem, big sacaton, Hartweg paspalum, and marshhay cordgrass are replaced by gulf cordgrass, paspalums, dropseeds, bushy bluestem, silver bluestem, buffalograss, and common bermudagrass. If close grazing continues over a long period, gulf cordgrass, shoregrass, and woody plants increase significantly.

Sandy Hill range site. The Falfurrias soils (map units FfC and SfC) are in this site. The climax vegetation is open grassland dominated by tall and mid grasses with a motte of live oak or mesquite trees. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

About 70 percent of the climax vegetation is made up of seacoast bluestem, indiangrass, little bluestem, big bluestem, crinkleawn, tanglehead, and gulfdune paspalum. Other grasses are knotroot bristlegrass, balsamscale, brownseed paspalum, longtom, fringeleaf

paspalum, and Wright threeawn. Forbs include partridge pea, croton, sensitivebrier, bundleflower, snoutbean, western indigo, dotted gayfeather, yellow neptunia, and annuals. Woody plants are live oak, mesquite, pricklypear, bullnettle, and spiny hackberry.

If retrogression occurs as a result of heavy grazing, seacoast bluestem, big bluestem, indiangrass, little bluestem, crinkleawn, and tanglehead are replaced by brownseed paspalum, longtom, fringeleaf paspalum, balsamscale, and Wright threeawn. If close grazing continues over a long period, sandbur, red lovegrass, fringed signalgrass, and pricklypear increase significantly.

Sandy Loam range site. The Copano and Inez soils (map units Co and In) are in this site (fig. 17). The climax vegetation is a savannah with about 20 to 35 percent canopy and an understory dominated by mid and tall grasses. The composition, by weight, is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

About 50 percent of the climax vegetation is little bluestem. Other grasses are seacoast bluestem, indiangrass, big bluestem, switchgrass, eastern gamagrass, brownseed paspalum, sideoats grama, dropseeds, threeawns, longtom, knotroot bristlegrass, balsamscale, jointtail, fall witchgrass, low panicums, and paspalums. Woody plants are post oak, blackjack oak, live oak, hackberry, American beautyberry, mustang grape, greenbrier, and peppervine. Forbs include Engelmann daisy, dotted gayfeather, sensitivebrier, bundleflower, yellow neptunia, snoutbean, partridge pea, goldenrod, croton, ragweed, and annuals.

If retrogression occurs as a result of heavy grazing, little bluestem, seacoast bluestem, indiangrass, big bluestem, switchgrass, and eastern gamagrass are replaced by brownseed paspalum, longtom, knotroot bristlegrass, dropseeds, threeawns, balsamscale, and jointtail. If close grazing continues over a long period, sandbur, windmillgrass, bitter sneezeweed, prairie coneflower, and woody plants increase significantly.

Tight Sandy Loam range site. The Papalote soils (map units PtA, PtB, and PtC) are in this site. The climax vegetation is open grassland dominated by mid grasses with scattered trees and shrubs. The composition, by

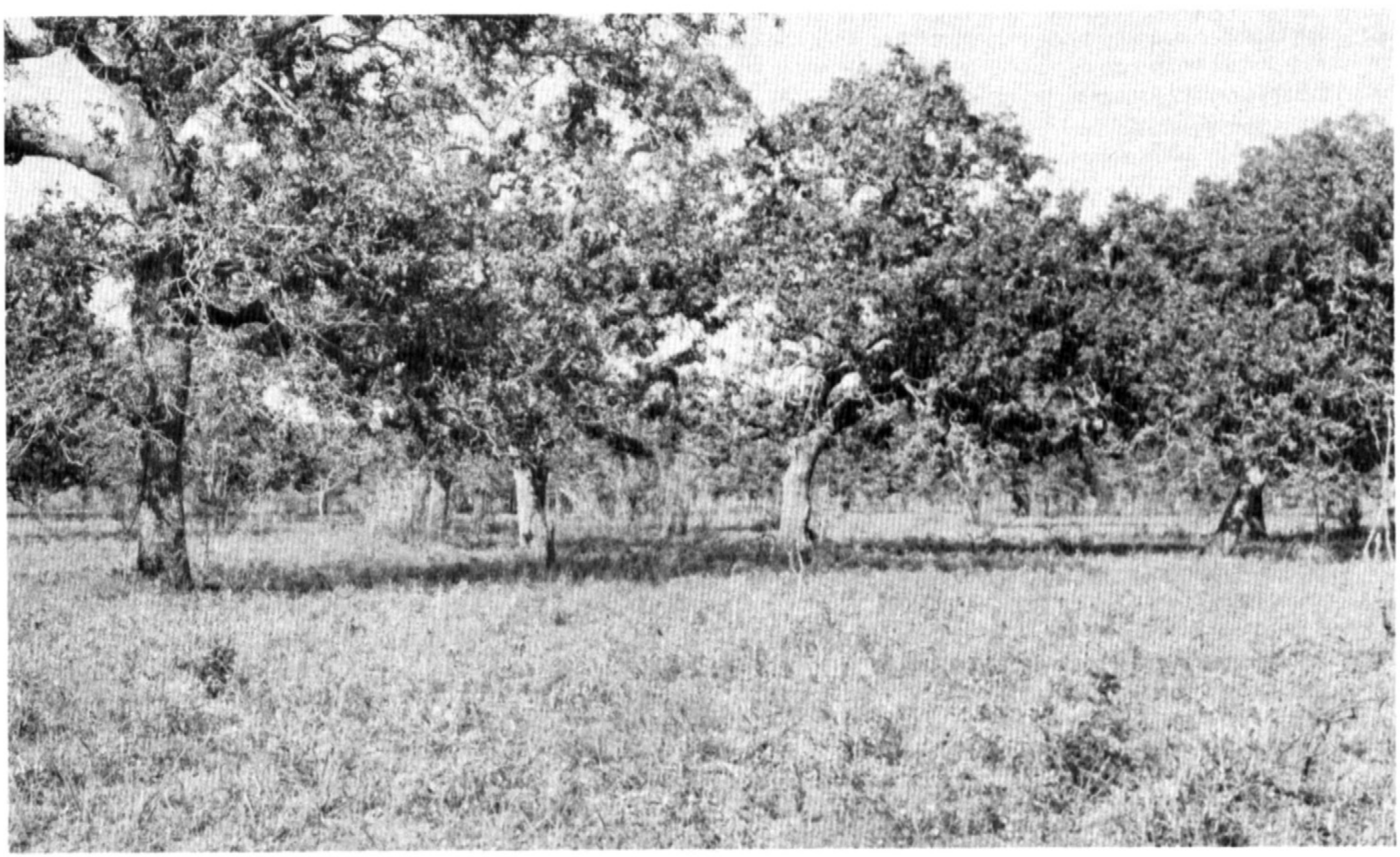


Figure 17.—This area of the Sandy Loam range site is in good condition. The soil in this area is Inez fine sandy loam.

weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

About 50 percent of the climax vegetation is made up of little bluestem, trichloris, tanglehead, windmillgrass, and sideoats grama. Other grasses are lovegrass tridens, bristlegrass, lovegrass, curlymesquite, buffalograss, and silver bluestem. Forbs include orange zexmania, Engelmann daisy, sunflower, perennial legumes, and annuals. Woody plants are live oak, post oak, mesquite, spiny hackberry, and kidneywood.

If retrogression occurs as a result of heavy grazing, little bluestem, trichloris, and tanglehead are replaced by silver bluestem, bristlegrass, windmillgrass, dropseeds, and smutgrass. If close grazing continues over a long period, red grama, Texas grama, sandbur, crotons, broomweed, ragweed, and threeawns increase significantly.

Recreation

In table 7, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Jerry Turrentine, biologist, and Kenneth Smith, range conservationist, Soil Conservation Service, helped plan and write this section.

The wide variety of soils in Refugio County support wetland and upland wildlife habitat. Consequently, the diversity of wildlife found in the county is among the highest within the state.

Most of the nationally recognized wetland types and wetland systems are within the county. The wetland areas, including tidal marshes and estuaries, provide habitat for various waterfowl, shore birds, wading birds, gulls, terns, rails, cranes, reptiles, and amphibians. During migration, waterfowl use the wetland areas and adjacent cropland for resting and feeding. Snow, white-fronted, and Canadian geese; pintail, widgeon, gadwall, green-winged teal, and mallard ducks; and sandhill cranes use these areas.

Several threatened or endangered species utilize these habitats as wintering grounds or as year-round homes. They include the whooping crane, southern bald

eagle, brown pelican, reddish egret, American peregrine falcon, and the American alligator.

The soils on uplands provide habitat for numerous species of openland and rangeland wildlife. Mammals inhabiting these areas include white-tailed deer, javelina, raccoon, opossum, cottontail rabbit, jack rabbit, skunk, armadillo, bobcat, wild hogs, bat, squirrel, and coyote. Birds that inhabit the county include the Rio Grande turkey, bobwhite quail, mourning dove, sandhill crane, Attwater's prairie chicken, vermillion flycatcher, and western kingbird. Numerous species of hawks, owls, woodpeckers, flycatchers, swallows, thrashers, thrushes, warblers, buntings, and sparrows are also in the area.

Fish, reptiles, and amphibians are numerous in wet habitats. Many ponds are stocked with channel catfish, black bass, and sunfish. The Mission, San Antonio, Guadalupe, and Aransas Rivers contain numerous fresh and salt water fish including catfish, black bass, carp, sunfish, gar, redfish, and drum. The bays and estuarine areas are important for shrimp, crab, sea-trout, flounder, shark, dolphin, and other salt water species.

Successful management of wildlife on any tract of land requires food, cover, and water to be available in a suitable combination. The absence of any one of these, an unfavorable balance among them, or an inadequate distribution can severely limit or account for the absence of a desired kind of wildlife. Soil information can provide a valuable tool in creating, improving, or maintaining suitable food, cover, and water for wildlife.

Soil interpretations for wildlife habitats aid in selecting the more suitable sites for specific animals or birds and serve as indicators of the level of management needed to achieve satisfactory results. The interpretations are also important where wildlife is a secondary land use and management decisions may be compromised.

Proper management of wildlife habitat areas is important. In openland habitat areas, corn and grain sorghum provide food for dove and quail. Small grains are grazed by geese and by deer if suitable cover is nearby. Crop residue left on the surface provides forage for numerous species of wildlife. Small areas of unharvested grain provide food and cover.

Waterways can be managed to afford cover for small mammals and birds. Fence rows that are left untrimed provide additional cover. Disking field borders greatly increases the food supply for wildlife. Brushy areas in pastures are an important source of food and cover. Improved grasses, such as kleingrass, provide seed and cover for birds.

Management of rangeland habitat includes several rangeland improvement practices. Proper grazing use, planned grazing systems, prescribed burning, and deferred grazing increase the production of forage for wildlife. A good vegetative cover provides cover for quail and turkey and fawning areas for deer. Grasses, if allowed to mature, provide seed for dove, quail, and turkey. Brush cleared in strips and patterns creates a diversity of food sources for various species of wildlife. Disking and food plantings also benefit wildlife.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, salinity, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are kleingrass, lovegrass, switchgrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil

properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, longtom, crotons, panicums, and partridge pea.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are blackbrush, agarita, granjeno, huisache, mesquite, and oaks.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning dove, sandhill crane, prairie chicken, meadowlark, field sparrow, cottontail, coyote, and fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, kingfishers, and nutria.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include white-tailed deer, jackrabbit, meadowlark, bobcat, javelina, coyote, wild hogs, and turkey.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet, and because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to: evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. Depth to a high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, depth to a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, depth to a high water table, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many

local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, depth to a water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the

water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and releases a variety of plant-available nutrients as it decomposes.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for drainage and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 16.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 16.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area, or from nearby areas, and on field examination.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They influence the soil's adsorption of cations, moisture retention, shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Mustang soils are assigned to two hydrologic soil groups. These soils have a permanent high water table that fluctuates somewhat with the tides and rainfall. When the soil is dry and the water table is deep, Mustang soils fall within the criteria for Group A. When the soil is wet, it falls within the criteria for Group D.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (there is a near 0 to 5 percent chance of flooding in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (there is a 5 to 50 percent chance of flooding in any year). *Frequent* means that flooding occurs often under normal weather conditions (there is more than a 50 percent chance of flooding in any year). *common* is used when classification as occasional or frequent does not affect interpretations. Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). The time of year that floods are most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely, thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, *perched* or *apparent;* and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water

stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

The two numbers in the "High water table-Depth" column indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severely corrosive environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 16 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Specific gravity (particle index)—T100 (AASHTO), D653 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(16)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aqualf (*Aqu*, meaning water, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Albaqualfs (*Alb*, meaning a nearly white eluvial horizon near the surface, plus *aqualf*, the suborder of the Alfisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Albaqualfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, hyperthermic Typic Albaqualfs. The Inez and Wyick soils are examples.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series. The Papalote series is an example.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (15)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (16)*. Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aransas Series

The Aransas series consists of deep, clayey soils on nearly level flood plains. These soils formed in calcareous, clayey alluvial sediment. Slopes are 0 to 1 percent.

Typical pedon of Aransas clay, frequently flooded; from U.S. Highway 77 in Woodsboro, 0.8 mile east on Farm Road 136, 6.4 miles south and east on Farm Road

1360, 2.1 miles south on a paved county road, 0.3 mile east on a private road, and 600 feet north, in rangeland.

A1—0 to 4 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate very fine and fine subangular blocky structure; very hard, firm, plastic and sticky; many fine roots; many fine pores; few wormcasts; few snail shells and shell fragments; calcareous, moderately alkaline; clear smooth boundary.

A2—4 to 28 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium angular and subangular blocky structure; extremely hard, very firm, plastic and sticky; common fine roots; common fine pores; few wormcasts; few shell fragments; calcareous, moderately alkaline; gradual wavy boundary.

Akc—28 to 49 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; extremely hard, very firm, plastic and sticky; few fine roots; few fine pores; few pressure faces; few shell fragments; few fine calcium carbonate concretions; few fine black concretions; calcareous, moderately alkaline; gradual wavy boundary.

Ckcg—49 to 60 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; massive; extremely hard, very firm, plastic and sticky; few shell fragments; about 10 percent, by volume, calcium carbonate concretions; few fine black concretions; calcareous, moderately alkaline.

The solum ranges in thickness from 35 to 50 inches. Reaction is moderately alkaline or strongly alkaline. The soil is nonsaline to strongly saline. In some pedons, calcium carbonate concretions, shells, and shell fragments occur throughout the profile. Black concretions range from none to few. COLE ranges from 0.09 to about 0.20 to a depth of 20 to 40 inches, and the PLE is more than 6 centimeters to a depth of 40 inches.

The A horizon is black or very dark gray. The 10- to 40-inch control section is clay or clay loam. Clay content is 35 to 60 percent.

The C horizon is light gray, gray, or dark gray. It has none to common mottles in shades of brown, yellow, or gray.

Barrada Series

The Barrada series consists of deep, clayey soils on nearly level coastal tidelands. These soils formed in saline, calcareous, clayey marine sediment. Slopes are 0 to 0.5 percent.

Typical pedon of Barrada clay; from U.S. Highway 77 in Refugio, 1.5 miles east on Farm Road 774, 9.6 miles south on Farm Road 2678, 5.2 miles south on Farm Road 136 to Bayside, 1 mile west and 0.9 mile south on county road and field road to bluff, 500 feet southeast of bluff along north shore of Copano Bay, on tidal flat.

Cz1—0 to 4 inches; light gray (10YR 6/1) clay, dark gray (10YR 4/1) moist; massive; extremely hard, firm, plastic and sticky; few shell fragments; strongly saline; calcareous, strongly alkaline; clear smooth boundary.

Cz2—4 to 24 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; few fine faint gray mottles and streaks and few fine distinct brown and yellow mottles; massive; extremely hard, firm, plastic and sticky; few shell fragments; few salt crystals; few thin lenses of sandy material; strongly saline; calcareous, strongly alkaline; gradual smooth boundary.

Cz3—24 to 50 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; few fine faint gray mottles and streaks and few coarse distinct brown and yellow mottles; massive; extremely hard, firm, plastic and sticky; few shell fragments; few fine dark concretions; strongly saline; calcareous, strongly alkaline; diffuse boundary.

Cz4—50 to 54 inches; light gray (10YR 7/2) clay, grayish brown (10YR 5/2) moist; few fine faint brownish yellow and gray mottles, few shell fragments; strongly saline; calcareous, strongly alkaline.

The soil is 36 to more than 50 inches thick to loamy material. Clay content of the control section ranges from 45 to 60 percent. Shells and fragments make up 0 to 10 percent, by volume. The soil is saturated to the surface for periods of 4 to 6 months and is never dry below a depth of about 8 inches. A permanent high water table is at a depth of less than 36 inches. The estimated *n* value ranges from about 0.6 to 0.8. The soils are strongly saline, strongly alkaline, and calcareous throughout. Elevation ranges from sea level to about 3 feet.

All horizons are dark grayish brown, grayish brown, dark gray, light brownish gray. They have few to many mottles in shades of gray, brown, and yellow. Some pedons contain thin lenses of crystaline salts or sandy material. The Cz horizon is clay or silty clay. Some pedons have a 2Cz horizon below a depth of 36 inches that is silty clay, silty clay loam, or loam.

Copano Series

The Copano series consists of deep, loamy soils on nearly level to slightly depressional uplands. These soils formed in clayey and loamy sediments. Slopes range from 0 to 2 percent.

Typical pedon of Copano fine sandy loam; from U.S. Highway 77 in Refugio, 4.5 miles east on Farm Road 774, 3.1 miles north and northeast on a paved oil lease road, 0.1 mile north on a gravel road, 0.3 mile east on pipeline right-of-way, and 20 feet south, in rangeland.

A—0 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine and very fine subangular blocky structure; slightly hard, very friable; common fine and very fine roots; common fine and very fine pores; few fine faint organic stains on ped surfaces; neutral; clear wavy boundary.

E—12 to 14 inches; light gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; weak very fine subangular blocky structure; slightly hard, very friable; common fine and very fine roots; common fine and very fine pores; neutral; abrupt wavy boundary.

Btg—14 to 23 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; common fine and medium distinct dark yellowish brown (10YR 4/6) mottles and few fine faint light gray mottles; moderate medium prismatic structure parting to moderate fine and medium blocky; extremely hard, very firm; common fine roots; common fine pores; common very dark gray (10YR 3/1) vertical streaks along old cracks; thick continuous clay films on ped surfaces; neutral; clear wavy boundary.

Btgc—23 to 42 inches; light gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) moist; common medium prominent dark yellowish brown (10YR 4/6) mottles and few fine faint gray mottles; moderate fine and medium blocky structure; very hard, very firm; few fine roots; few fine pores; few dark grayish brown (10YR 4/2) vertical streaks extending into horizon below; few thin discontinuous clay films on ped surfaces; few fine and medium black concretions 1 to 5 mm in diameter; mildly alkaline; gradual wavy boundary.

BCc—42 to 56 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; common fine faint brownish yellow mottles; moderate medium subangular blocky structure; very hard, very firm; few fine roots; common fine and medium black concretions 1 to 5 mm in diameter; moderately alkaline; gradual wavy boundary.

Ckc—56 to 72 inches; white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) moist; massive; very hard, very firm; few fine black concretions 1 to 2 mm in diameter; about 5 percent, by volume, calcium carbonate concretions and masses 2 to 8 mm in diameter; calcareous, moderately alkaline.

The solum ranges in thickness from 40 to more than 60 inches. Depth to free carbonates is more than 32 inches. Most pedons have a few black concretions. The soil cracks when dry, but cracks rarely extend to the surface. Clay content of the control section ranges from 38 to 55 percent. COLE ranges from 0.09 to 0.11.

The A horizon is grayish brown, dark grayish brown, brown, light brownish gray, or light gray. It ranges from 9 to 18 inches thick. Reaction is medium acid to neutral.

The E horizon is light brownish gray, light gray, pale brown, or very pale brown. It is 1 inch to 3 inches thick. Reaction is medium acid to neutral. Some pedons do not have an E horizon.

Some pedons have a BE horizon 1 inch to 3 inches thick. It is dark gray or very dark gray. The texture is fine sandy loam or sandy clay loam. Reaction is medium acid to neutral.

The Btg and Btgc horizons are dark gray, gray, grayish brown, light brownish gray, or light gray. These horizons have few to many horizons in shades of yellow, brown, red, and gray. The Btg and Btgc horizons combined range from 12 to 41 inches thick. The texture is clay or sandy clay. Reaction is neutral to moderately alkaline. Some pedons have dark gray coatings on ped surfaces.

The BC horizon is gray, light gray, light brownish gray, very pale brown, or white. It has none to common mottles in shades of yellow, brown, red, and gray. The horizon ranges from 6 to 17 inches thick. The texture is sandy clay loam, clay loam, or sandy clay. Reaction is mildly alkaline or moderately alkaline. The matrix is noncalcareous or calcareous. In some pedons, vertical dark gray streaks and cracks are in the upper 1 inch or 2 inches of this horizon. Calcium carbonate concretions and masses range from none to common.

The C horizon is light gray, very pale brown, pale yellow, or white. It has none to few mottles in shades of yellow and brown. The texture is sandy clay loam, clay loam, or sandy clay. Reaction is moderately alkaline. The matrix is calcareous or noncalcareous. Calcium carbonate concretions and masses range from 0 to about 15 percent, by volume.

Dietrich Series

The Dietrich series consists of deep, sandy soils on nearly level low coastal plains. These soils formed in saline, loamy and sandy marine sediments. Slopes are 0 to 1 percent.

Typical pedon of Dietrich loamy fine sand; 0.5 mile south of Austwell on Farm Road 774, 3.2 miles southeast on Farm Road 2040, 0.1 mile east on a private road, and 50 feet north, in rangeland.

A—0 to 7 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained; slightly hard, very friable; many fine and medium roots; neutral; clear wavy boundary.

E—7 to 9 inches; light gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) moist; single grained; slightly hard, very friable; common fine and medium roots; neutral; abrupt wavy boundary.

Btng1—9 to 18 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; common fine faint and distinct red, yellow, brown, and gray mottles; moderate coarse columnar structure parting to moderate medium

blocky; very hard, very firm, plastic and sticky; thin light gray fine sandy loam caps on columns; few fine roots between peds; ped surfaces coated with dark gray (10YR 4/1) clay films; very slightly saline; mildly alkaline; clear wavy boundary.

Btng2—18 to 30 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/2) moist; common medium distinct yellow, brown, and gray mottles; moderate coarse and medium angular blocky structure; very hard, very firm, plastic and sticky; ped surfaces coated with dark gray (10YR 4/1) clay films; few gray streaks in upper 3 inches; very slightly saline; moderately alkaline; gradual smooth boundary.

BCncg—30 to 44 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; few fine faint yellow and brown mottles; weak coarse blocky structure; very hard, firm; few thin clay films on ped surfaces; few gray streaks; few fine black concretions; slightly saline; moderately alkaline; gradual smooth boundary.

Ckc—44 to 60 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; common fine distinct yellow and brown mottles; massive; hard, firm; few fine and medium black concretions; few fine calcium carbonate concretions; slightly saline; moderately alkaline.

The solum ranges in thickness from 34 to 60 inches. The soil is nonsaline to moderately saline. Some pedons contain up to 3 percent, by volume, calcium carbonate concretions and masses in the lower part of the Bt horizon and in the C horizon. Many pedons contain a few threads and pockets of salt crystals in the lower part of the solum. Elevation ranges from about 2 to 10 feet above sea level.

The A horizon is grayish brown, light brownish gray, gray, or pale brown. It is 7 to 15 inches thick. Reaction is slightly acid or neutral.

The E horizon is light gray or light brownish gray. It ranges to 4 inches thick. Some pedons do not have an E horizon.

The Bt horizon is dark grayish brown, grayish brown, light brownish gray, light gray, or gray. The few to many mottles are fine or medium and are distinct. They are in shades of red, yellow, brown, and gray. The texture is clay loam, loam, or sandy clay loam. Reaction is mildly alkaline or moderately alkaline. Clay films and organic coatings on ped surfaces are very dark gray, dark gray, gray, or black. Exchangeable sodium is more than 15 percent.

The C horizon is light brownish gray or light gray. The texture is loam or sandy clay loam.

Edroy Series

The Edroy series consists of deep, clayey soils on nearly level and depressional uplands. These soils formed in clayey sediment underlain by loamy or sandy material. Slopes are 0 to 1 percent.

Typical pedon of Edroy clay, depressional; from U.S. Highway 183 in Refugio, 20 miles north on U.S. Highway 77, 2 miles east on Farm Road 239, 1.5 miles south on a private ranch road, 0.7 mile west on a private ranch road, and 50 feet south, in rangeland.

A1—0 to 12 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium granular and subangular blocky structure; very hard, very firm, plastic and sticky; many fine roots; brown stains along old root channels; few cracks; neutral; gradual smooth boundary.

A2—12 to 28 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium blocky and subangular blocky structure; very hard, very firm, plastic and sticky; common fine roots; brown stains along old root channels; few cracks filled with light color sandy material; few pressure faces; neutral; gradual wavy boundary.

Bg—28 to 35 inches; light brownish gray (10YR 6/2) sandy clay, grayish brown (10YR 5/2) moist; few fine faint light gray and very pale brown mottles; moderate medium prismatic structure parting to moderate fine and medium blocky; very hard, very firm, plastic and sticky; few fine roots mainly between peds; brown stains along old root channels; few dark streaks along old cracks; pressure faces; mildly alkaline; gradual wavy boundary.

Bcg—35 to 42 inches; light gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) moist; few fine faint grayish brown and very pale brown mottles; moderate medium prismatic structure parting to weak medium blocky; extremely hard, very firm, plastic and sticky; few fine roots mainly between peds; few fine black concretions; moderately alkaline; gradual wavy boundary.

Bkcg—42 to 47 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few fine faint yellow and brown mottles; weak medium prismatic structure parting to weak fine and medium blocky; extremely hard, very firm, plastic and sticky; few fine black concretions; few fine calcium carbonate concretions; moderately alkaline; gradual wavy boundary.

Ckc—47 to 60 inches; very pale brown (10YR 8/4) sandy clay loam, very pale brown (10YR 7/4) moist; few fine faint yellow and brown mottles; massive; hard, friable; few fine black concretions; few fine calcium carbonate concretions; moderately alkaline.

The solum ranges in thickness from 40 to 70 inches. The dry soil has cracks 0.5 to 1 inch wide that extend to a depth of about 30 inches. Clay content of the control section ranges from 35 to 50 percent. Some pedons

have a grayish brown fine sandy loam layer 0.5 inch to 2 inches thick on the surface. It has apparently washed or blown in from the surrounding higher-lying soils. Some pedons are weakly calcareous below a depth of 20 inches.

The A horizon is very dark gray, dark gray, or gray. It is 15 to 28 inches thick. Reaction is slightly acid or neutral.

The Bg and Bcg horizons are gray, light gray, grayish brown, or light brownish gray. Mottles in shades of gray or brown range from faint to distinct. The texture is clay, sandy clay, or clay loam. Reaction is mildly alkaline or moderately alkaline.

The Bkcg horizon is gray, light gray, or light brownish gray. The texture is loam, clay loam, or sandy clay loam. Reaction is moderately alkaline. This horizon is calcareous. Black and calcium carbonate concretions range from few to none.

The C horizon is light gray, white, or very pale brown. The texture is clay loam or sandy clay loam. Reaction is moderately alkaline or strongly alkaline. Some pedons have a 2Cg horizon that is fine sandy loam or loamy fine sand.

Faddin Series

The Faddin series consists of deep, loamy soils on nearly level uplands. These soils formed in loamy and clayey sediments. Slopes are 0 to 1 percent.

Typical pedon of Faddin fine sandy loam; from U.S. Highway 183 in Refugio, 11.3 miles north on U.S. Highway 77, 6.4 miles northwest on a private ranch road to Welder west ranch headquarters, 1.4 miles north on a private ranch road, and 300 feet west, in rangeland.

A—0 to 19 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular and subangular blocky structure; slightly hard, very friable, common fine roots; slightly acid; clear wavy boundary.

Btcg1—19 to 27 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; common fine and medium distinct red (2.5YR 4/6) and yellowish brown (10YR 5/6) mottles; moderate fine and medium blocky structure; very hard, very firm; few fine roots mainly between peds; dark gray clay films on ped surfaces; common pressure faces; few vertical dark streaks; few fine black concretions; slightly acid; clear wavy boundary.

Btcg2—27 to 39 inches; light brownish gray (10YR 6/2) sandy clay, grayish brown (10YR 5/2) moist; common fine and few medium distinct strong brown (7.5YR 5/6) and brownish yellow (10YR 6/8) mottles; moderate medium blocky structure; very hard, very firm; few fine roots between peds; dark gray clay films on ped surfaces; common pressure faces; few vertical dark streaks; common fine black concretions; slightly acid; gradual smooth boundary.

Btkgc—39 to 52 inches; light gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) moist; common fine and medium distinct brownish yellow (10YR 6/8) and strong brown (7.5YR 5/6) mottles; moderate medium blocky structure; very hard, very firm; few fine roots; common streaks of gray material; few vertical dark streaks; common fine black concretions; few fine calcium carbonate concretions and masses; noncalcareous, mildly alkaline; gradual smooth boundary.

BCkc—52 to 60 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; weak fine and very fine subangular structure; hard, firm; few streaks and splotches of gray material; few fine black concretions; few fine calcium carbonate concretions and masses; calcareous, moderately alkaline.

The solum is more than 60 inches thick. Reaction is slightly acid or neutral in the A horizon, slightly acid to mildly alkaline in the Btgc horizon, and mildly alkaline or moderately alkaline in the Btkgc and BC horizons. Combined thickness of the A and E horizons is more than 12 inches in more than 50 percent of the pedon and ranges up to 20 inches.

The A horizon is dark grayish brown, dark gray, gray, or grayish brown.

Some pedons have an E horizon that is light brownish gray, light gray, or white. The texture is fine sandy loam or very fine sandy loam. This horizon is 1 inch to 3 inches thick.

The Btgc and Btkgc horizons are very dark gray, dark gray, gray, dark grayish brown, light brownish gray, or grayish brown. They have few to many, fine to coarse, and faint to distinct mottles in shades of red, brown, and yellow. The texture is clay or sandy clay. Clay content ranges from 35 to 50 percent.

The BC horizon is gray, yellowish brown, brown, grayish brown, light brownish gray, pale brown, very pale brown, light gray, or light yellowish brown. The texture is sandy clay loam or sandy clay. In most pedons, this horizon contains a few fine black concretions. In some pedons, a few calcium carbonate concretions and masses are below a depth of about 36 inches.

Falfurrias Series

The Falfurrias series consists of deep, sandy soils on nearly level to hummocky uplands and terraces. These soils formed in thick, sandy sediment. Slopes range from 0 to 5 percent.

Typical pedon of Falfurrias fine sand, in an area of Sarita-Falfurrias fine sands, 0 to 5 percent slopes; from U.S. Highway 183 in Refugio, 20.6 miles north on U.S. Highway 77, 1.4 miles west on a private ranch road, and 1,200 feet north, in rangeland.

A1—0 to 9 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; common fine roots; neutral; clear smooth boundary.
A2—9 to 30 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose; few fine roots; neutral; diffuse smooth boundary.
C—30 to 99 inches; very pale brown (10YR 8/4) fine sand, very pale brown (10YR 7/4) moist; single grained; loose; neutral.

The soil is 80 to more than 99 inches thick. Reaction throughout the profile ranges from slightly acid to moderately alkaline.

The A horizon is grayish brown, light brownish gray, light brown, brown, pale brown, or very pale brown.

The C horizon is light brownish gray, very pale brown, pale brown, pink, yellow, or light yellowish brown.

Galveston Series

The Galveston series consists of deep, sandy soils on nearly level to gently undulating, duned coastal plains. These soils formed in sandy sediment that has been reworked by wind and wave action. Slopes range from 0 to 3 percent.

Typical pedon of Galveston fine sand, in an area of Galveston-Mustang fine sands, 0 to 3 percent slopes; from the Refugio-Aransas county line marker on Farm Road 2040, 0.8 mile west along fence line, and 350 feet north, in rangeland.

A—0 to 4 inches; gray (10YR 6/1) fine sand; gray (10YR 5/1) moist; single grained; loose; many fine roots; neutral; clear smooth boundary.
C1—4 to 44 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; single grained; loose; few fine roots; few fine shell fragments; mildly alkaline; diffuse smooth boundary.
C2—44 to 80 inches; white (10YR 8/2) fine sand; light gray (10YR 7/2) moist; few fine faint yellow mottles and streaks; few fine roots; few fine shell fragments; mildly alkaline.

Depth to loamy strata is more than 72 inches but less than 140 inches in most pedons. The soil is light brownish gray, light gray, gray, white, pale brown, or very pale brown. Reaction is medium acid to moderately alkaline. Some pedons are saline. Texture of the C horizon is fine sand or sand. Some pedons nearest to marine regimes have a few fine shell fragments. A permanent high water table, that fluctuates somewhat with the tides and rainfall, is between depths of 40 and 72 inches during most of the year. Elevation ranges from about 4 to 30 feet above sea level.

Inez Series

The Inez series consists of deep, loamy soils on nearly level to gently undulating upland and stream terraces (fig. 18). These soils formed in clayey sediment. Slopes are 0 to 1 percent.

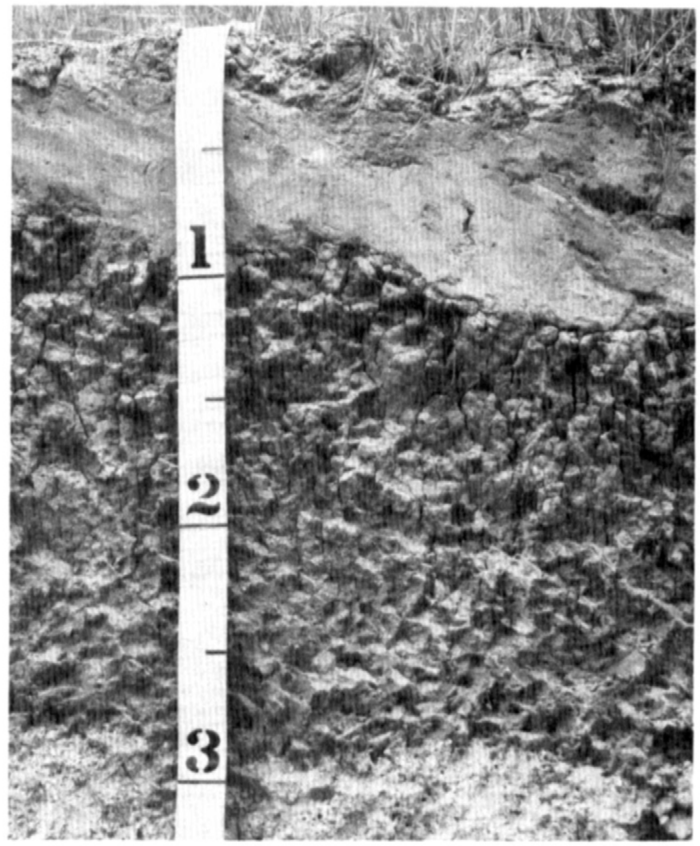


Figure 18.—Inez fine sandy loam has an abrupt wavy boundary between the sandy surface layer and the clayey lower layers.

Typical pedon of Inez fine sandy loam; from the intersection of U.S. Highway 183 and Texas Highway 202 about 2 miles northwest of Refugio, 6 miles north on U.S. Highway 183 to McGill Road, 0.75 mile west on McGill Road, and 150 feet north, in rangeland.

A—0 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; few fine faint yellowish brown mottles; weak fine granular structure; hard, friable; many fine roots; slightly acid; abrupt smooth boundary.
E—10 to 14 inches; light gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; few fine faint yellowish brown mottles; weak fine granular structure; hard, friable; many fine and medium roots; slightly acid; abrupt wavy boundary.

Btg—14 to 24 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common coarse and medium distinct gray (10YR 6/1) mottles and common fine faint and distinct brownish yellow, yellowish brown, and yellowish red mottles; weak coarse prismatic structure parting to weak medium angular blocky; extremely hard, extremely firm, plastic and sticky; common fine and medium roots; few vertical dark gray streaks; common pressure faces; clay films; thin film of clean sand grains on ped surfaces; strongly acid; gradual wavy boundary.

Btcg1—24 to 36 inches; light gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; common medium prominent brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) mottles and few medium prominent yellowish red (5YR 4/8) mottles; weak coarse and medium prismatic structure parting to weak fine and medium angular blocky; extremely hard, extremely firm, plastic and sticky; few fine and medium roots; few vertical dark gray streaks; common pressure faces; clay films; dark coating on ped surfaces; few fine black concretions; medium acid; gradual wavy boundary.

Btcg2—36 to 48 inches; light gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/1) moist; common medium distinct brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) mottles; weak medium angular blocky structure; extremely hard, extremely firm; slightly plastic and sticky; few fine roots; few vertical dark gray streaks; few pressure faces; few thin clay films; dark coating on ped surfaces; few fine black concretions and masses; slightly acid; gradual wavy boundary.

BCcg—48 to 64 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few fine distinct brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) mottles; weak coarse angular blocky structure; extremely hard, extremely firm, slightly plastic and sticky; few fine black concretions and masses; mildly alkaline.

The solum ranges in thickness from 60 to more than 80 inches. Depth to free carbonates ranges from 40 to more than 60 inches. Most pedons have black concretions and masses ranging from few to common. They also have dark color vertical streaks reaching from the top of the Btg horizon to the lower part of the Btcg horizon.

The A and E horizons range from about 10 to 20 inches thick. They are light gray, gray, dark gray, light brownish gray, grayish brown, or dark grayish brown. The E horizon is mainly one value lighter than the A horizon. Mottles in shades of brown, yellow, red, and gray range from few to common. Reaction ranges from medium acid to neutral.

The Btg and Btcg horizons are light gray, gray, dark gray, light brownish gray, grayish brown, or dark grayish brown. Mottles in shades of brown, yellow, and red range from few to many. The texture is clay or sandy clay. Reaction ranges from very strongly acid to neutral. Clay content ranges from about 35 to 55 percent. Most pedons have dark coatings or clean sand grains on ped surfaces.

The BCcg horizon is light gray, gray, dark gray, light brownish gray, grayish brown, or dark grayish brown. Mottles in shades of brown, yellow, and red range from none to many. The texture is sandy clay loam, clay loam, or sandy clay. Reaction ranges from neutral to moderately alkaline. Concretions and masses of calcium carbonate range from none to common. The matrix is typically noncalcareous.

Monteola Series

The Monteola series consists of deep, clayey soils on gently sloping to moderately sloping uplands. These soils formed in thick beds of clayey sediment. Slopes range from 3 to 8 percent.

Typical pedon of Monteola clay, 3 to 5 percent slopes; in microdepression, from U.S. Highway 77 in Woodsboro, 14 miles east and south on Farm Road 136, and 200 feet east, in pastureland.

A1—0 to 24 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine subangular blocky and granular structure; extremely hard, very firm, plastic and sticky; many fine and medium roots; common wormcasts and tunnels; cracks 0.5 inch wide extending into horizon below; few snail shells and fine shell fragments; few pressure faces; slickensides in lower part; few fine calcium carbonate concretions; calcareous, moderately alkaline; gradual wavy boundary.

A2—24 to 33 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine subangular blocky structure; extremely hard, very firm, plastic and sticky; common fine and medium roots; few wormcasts and tunnels; few old cracks filled with very dark gray soil; few snail shells and shell fragments; common pressure faces; few intersecting slickensides; few fine calcium carbonate concretions; calcareous, moderately alkaline; gradual wavy boundary.

Bky—33 to 58 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; about 36 percent very pale brown (10YR 7/3) streaks and splotches becoming lighter in color with depth; moderate fine and medium angular blocky structure; extremely hard, very firm, plastic and sticky; distinct parallelepipeds tilted about 35 degrees from horizontal; common pressure faces; few intersecting slickensides; few old cracks filled with dark gray soil; few cracks extending from horizon above; few fine roots; few shell fragments; few fine calcium carbonate concretions and masses;

few gypsum crystals in lower part; calcareous, moderately alkaline; gradual wavy boundary.

Ckny—58 to 72 inches; very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; massive; extremely hard, very firm, plastic and sticky; few pressure faces; few vertical dark streaks; few seams and pockets of gypsum crystals; common fine calcium carbonate concretions and masses; few films and threads of salt crystals; slightly saline; calcareous, moderately alkaline.

The solum ranges in thickness from 40 to 60 inches. The texture is clay throughout. Reaction is moderately alkaline to strongly alkaline. The soils are nonsaline to slightly saline.

The A horizon is thinnest on microknolls and thickest in microdepressions. Amplitude of waviness between the A and B horizons ranges from 5 to 14 inches. The A horizon is dark gray or very dark gray.

The Bky horizon is light brownish gray, grayish brown, dark grayish brown, brown, light olive brown, or dark brown with streaks and splotches of gray to very dark gray. It has gypsum crystals and calcium carbonate concretions ranging from few to many. Electrical conductivity ranges from 1 to about 4 millimhos per centimeter.

The C horizon is white, light gray, very pale brown, pale yellow, pale brown, light brownish gray, or olive yellow.

Mustang Series

The Mustang series consists of deep, sandy soils on nearly level to slightly depressional, low coastal plains. These soils formed in sandy sediment that has been reworked by wave and wind action. Slopes are 0 to 1 percent.

Typical pedon of Mustang fine sand, in an area of Galveston-Mustang fine sands, 0 to 3 percent slopes; from the Refugio-Aransas county line marker on Farm Road 2040, 0.75 mile west along fence line and 250 feet north, in rangeland.

A—0 to 6 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; many fine and medium roots; few shell fragments; mildly alkaline; gradual smooth boundary.

Cg1—6 to 16 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; common fine distinct brownish yellow mottles and streaks along old root channels; single grained; loose; common fine and medium roots; few fine shell fragments; mildly alkaline; gradual smooth boundary.

Cg2—16 to 80 inches; white (10YR 8/2) fine sand, light gray (10YR 7/2) moist; few fine and medium brownish yellow (10YR 6/6) mottles and streaks; single grained; loose; few fine shell fragments; mildly alkaline.

Depth to loamy strata or weakly consolidated layers of marine shells is 40 to more than 100 inches. Most areas of the Mustang soils are flooded by fresh water following heavy rainfall, and are saturated to the surface or covered by water for periods of several days to several weeks. A permanent high water table that fluctuates somewhat with the tides and rainfall is at a depth of less than 40 inches. Elevation ranges from about 3 to 12 feet above sea level.

The A horizon is dark gray, dark grayish brown, light brownish gray, or light gray. The Cg horizon is gray, grayish brown, light gray, or white. Silt plus clay is less than 10 percent. Reaction is neutral to moderately alkaline. Some pedons are saline. Most pedons contain few to common, fine to medium, brown or yellow mottles and streaks.

Narta Series

The Narta series consists of deep, saline, loamy soils on nearly level, low coastal plains (fig. 19). These soils formed in clayey and loamy marine sediments. Slopes are 0 to 1 percent.

Typical pedon of Narta fine sandy loam; from U.S. Highway 77 in Refugio, 7.3 miles east on Farm Road 774, 10.5 miles south and southeast on a private ranch road to north shore of Copano Bay, and 350 feet north, in rangeland.

A—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; many fine roots; few insect tunnels; slightly saline; moderately alkaline; abrupt smooth boundary.

Btnzg—7 to 20 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium columnar structure parting to moderate fine and medium blocky; extremely hard, very firm; many fine roots; few fine pores; discontinuous clay films on ped surfaces; thin layer of light color material capping columns; few fine salt crystals; moderately saline; moderately alkaline; clear smooth boundary.

Btknzg—20 to 42 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine and medium blocky structure; extremely hard, very firm, common fine roots; few fine pores; discontinuous clay films on ped surfaces; few fine calcium carbonate concretions; threads and films of salt crystals; moderately saline; calcareous, moderately alkaline; gradual smooth boundary.

BCknzg—42 to 54 inches; gray (10YR 6/1) clay, gray (10YR 5/1) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; few fine pores; common fine calcium carbonate

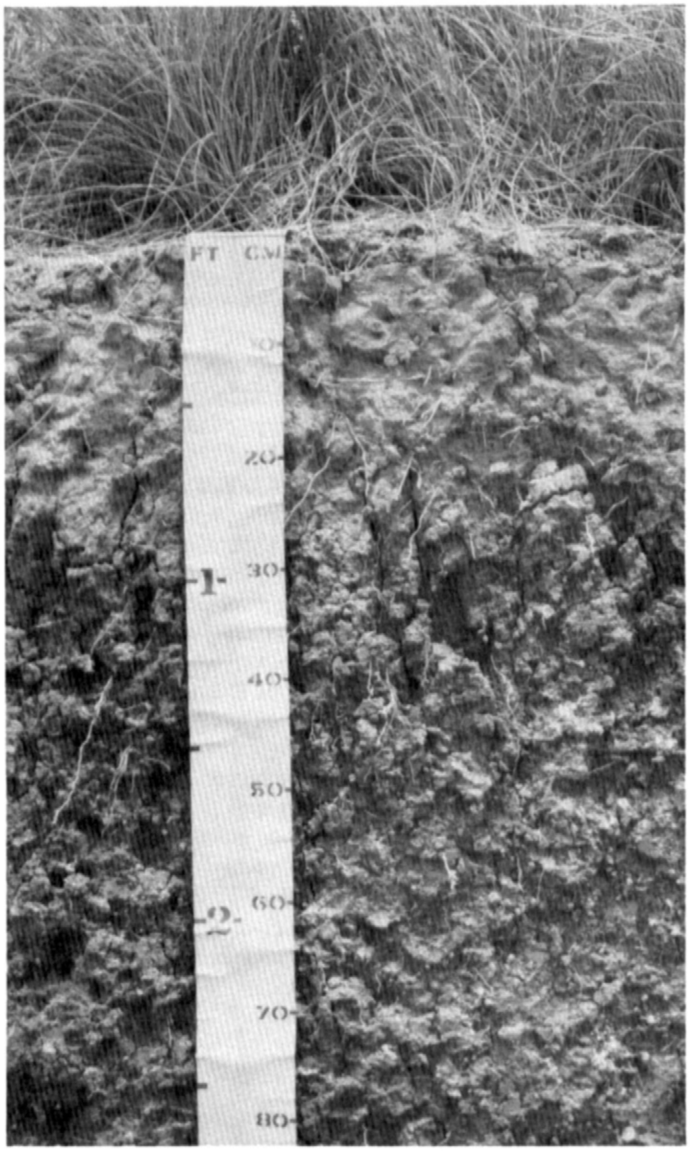


Figure 19.—The columnar structure of the natric horizon in Narta fine sandy loam is visible between depths of 6 and 18 inches.

concretions; few fine black concretions; threads and films of salt crystals; moderately saline; calcareous, strongly alkaline; gradual smooth boundary.

Cknz—54 to 60 inches; light gray (10YR 7/1) clay loam, gray (10YR 6/1) moist; few fine yellowish brown mottles; massive; hard, firm; few fine roots; common fine calcium carbonate concretions; few fine black concretions; few seams and pockets of salt crystals; moderately saline; calcareous, strongly alkaline.

The solum ranges in thickness from 30 to 60 inches. The soil is very slightly saline to slightly saline in the A horizon and slightly saline to strongly saline in the B and C horizons. Reaction is neutral to strongly alkaline. Elevation ranges from about 3 to 15 feet above sea level.

The A horizon is light gray, gray, dark gray, light brownish gray, grayish brown, or dark grayish brown. It is 3 to 10 inches thick.

The B horizon is light gray, gray, dark gray, light brownish gray, grayish brown, or dark grayish brown. Mottles in shades of brown and yellow range from none to common. The texture is clay, clay loam, silty clay, or silty clay loam. Clay content ranges from 35 to 45 percent. Exchangeable sodium ranges from about 15 to 45 percent. Calcium carbonate concretions and masses and black concretions range from none to common.

The BC and C horizons are gray, light gray, light brownish gray, or white. Mottles in shades of brown and yellow range from none to common. The texture is clay, sandy clay, or clay loam. Exchangeable sodium ranges from about 15 to 45 percent. Calcium carbonate concretions and masses and black concretions range from none to many.

Odem Series

The Odem series consists of deep, loamy soils on nearly level to gently undulating flood plains and low stream terraces (fig. 20). These soils formed in loamy and sandy alluvial sediments. Slopes range from 0 to 2 percent.

Typical pedon of Odem fine sandy loam, occasionally flooded; from U.S. Highway 77 in Woodsboro, 0.8 mile east on Farm Road 136, 6.4 miles south and east on Farm Road 1360, 2.1 miles south on a paved county road, 0.3 mile east on a private ranch road, and 50 feet south, in rangeland.

A1—0 to 11 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; many fine roots; mildly alkaline; gradual smooth boundary.

A2—11 to 36 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine granular and subangular blocky; slightly hard, very friable; common fine roots; neutral; gradual smooth boundary.

C—36 to 68 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few bedding planes; few thin strata of loamy fine sand and fine sand; neutral.

The A horizon ranges in thickness from 24 to more than 50 inches. It is gray, dark gray, very dark gray, grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. Reaction is slightly acid to moderately alkaline.

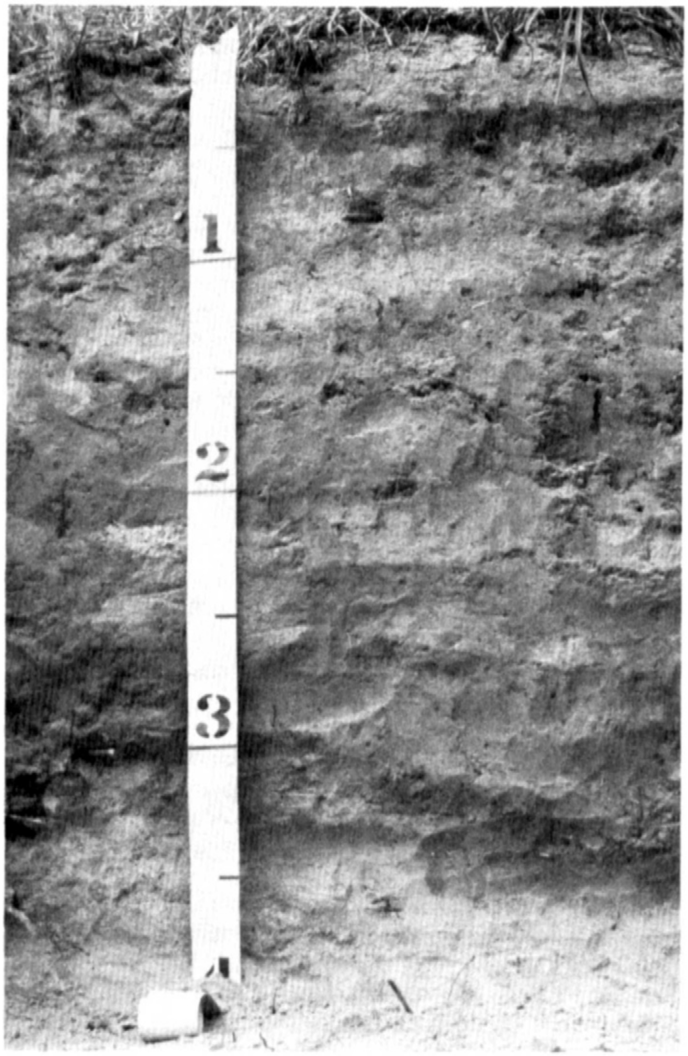


Figure 20.—Odem fine sandy loam, occasionally flooded, has thin layers of various textures in the lower part of the profile.

The C horizon is light gray, gray, light brownish gray, grayish brown, very pale brown, pale brown, or brown. It is stratified, and the average texture is fine sandy loam. Stratum ranges from sandy clay loam to fine sand. Reaction is neutral to moderately alkaline. Some pedons are calcareous. Clay content of the 10- to 40-inch control section is 10 to 18 percent.

Orelia Series

The Orelia series consists of deep, loamy soils on nearly level to slightly depressional uplands. These soils formed in loamy sediment. Slopes are 0 to 1 percent.

Typical pedon of Orelia fine sandy loam; from Farm Road 136 in Woodsboro, 3.4 miles south on U.S. Highway 77, 2.6 miles west on a private ranch road, 0.2 mile north along pipeline right-of-way, and 50 feet east, in rangeland.

A—0 to 6 inches; gray (10YR 5/1) fine sandy loam, dark gray (10YR 4/1) moist; massive; hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

Btg1—6 to 13 inches; very dark gray (10YR 3/1) sandy clay loam, black (10YR 2/1) moist; moderate coarse prismatic structure parting to moderate medium blocky; very hard, very firm; common fine roots; thin continuous clay films on ped surfaces; thin cap of white material on prisms; thin coating of white material on ped surfaces; neutral; clear smooth boundary.

Btg2—13 to 20 inches; very dark gray (10YR 3/1) sandy clay loam; black (10YR 2/1) moist; weak coarse prismatic structure parting to moderate medium blocky; very hard, very firm; few fine roots in upper part; thin continuous clay films; thin coating of white material on ped surfaces; mildly alkaline; gradual smooth boundary.

Bkg—20 to 37 inches; gray (10YR 5/1) sandy clay loam, dark gray (10YR 4/1) moist; weak medium blocky and subangular blocky structure parting to weak fine subangular blocky; very hard, friable; 3 to 5 percent calcium carbonate concretions and masses; calcareous, moderately alkaline; gradual smooth boundary.

Ck—37 to 60 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few medium faint brownish yellow (10YR 6/6) mottles; massive; hard, friable; 1 to 2 percent calcium carbonate concretions and masses; calcareous, moderately alkaline.

The solum ranges in thickness from 28 to 50 inches. The soil is nonsaline to moderately saline. In some pedons, few faint mottles in shades of yellow and brown are in the lower part of the Btg horizon and in the Bk and C horizons. Most pedons have a few fine black concretions in the lower part of the profile.

The A horizon is dark gray, gray, or grayish brown. It is 3 to 8 inches thick. Reaction is slightly acid to mildly alkaline. Exchangeable sodium ranges from about 3 to 8 percent. Electrical conductivity ranges from 0.4 to 4 millimhos per centimeter.

The Btg horizon is very dark gray, dark gray, or gray. The texture is sandy clay loam or clay loam. Clay content ranges from 27 to 35 percent. Reaction is neutral to moderately alkaline. Exchangeable sodium ranges from about 6 to 14 percent. Electrical conductivity ranges from 1 to 8 millimhos per centimeter.

The Bkg horizon is grayish brown, gray, light gray, or white. The texture is sandy clay loam. Reaction is mildly alkaline to strongly alkaline. Calcium carbonate

concretions and masses range from about 1 to 10 percent. Exchangeable sodium ranges from about 12 to 20 percent with values of more than 15 percent at a depth of more than 16 inches below the top of the Bt horizon. Electrical conductivity ranges from 1 to 12 millimhos per centimeter.

The C horizon is light gray, light brownish gray, or white. The texture is sandy clay loam or loam. Reaction is mildly alkaline to strongly alkaline. Calcium carbonate concretions and masses range from about 5 to 10 percent. Exchangeable sodium ranges from about 12 to 20 percent. Electrical conductivity ranges from 1 to 12 millimhos per centimeter.

Papalote Series

The Papalote series consists of deep, loamy soils on nearly level to gently sloping uplands. These soils formed in loamy and clayey sediments. Slopes range from 0 to 5 percent (fig. 21).

Typical pedon of Papalote fine sandy loam, 0 to 1 percent slopes; from U.S. Highway 183 in Refugio, 3.2 miles north on U.S. Highway 77, 0.9 mile southeast on a private road, and 100 feet south, in rangeland.

A—0 to 11 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; common fine roots; few fine pores; neutral; abrupt wavy boundary.

Bt1—11 to 18 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; few fine faint gray mottles and common fine faint yellowish brown mottles; weak medium prismatic structure parting to moderate medium blocky; very hard, firm; few fine roots; few fine pores; continuous clay films; neutral; clear wavy boundary.

Bt2—18 to 31 inches; light brownish gray (10YR 6/2) sandy clay, grayish brown (10YR 5/2) moist; common fine and medium distinct brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) mottles and few fine faint gray mottles; moderate medium prismatic structure parting to moderate medium blocky; very hard, firm; few fine roots; few fine pores; few dark streaks; continuous clay films; mildly alkaline; gradual wavy boundary.

Bt3—31 to 43 inches; light gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) moist; common fine and medium distinct brownish yellow (10YR 6/8) mottles and few fine faint gray mottles; weak medium prismatic structure parting to moderate medium blocky; very hard, firm; few fine roots; few dark streaks; discontinuous clay films; mildly alkaline; gradual wavy boundary.

Bkc—43 to 52 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; few fine faint yellow mottles; weak fine and medium subangular blocky structure; hard, firm; few calcium carbonate concretions and masses; few fine black concretions; calcareous, moderately alkaline; gradual wavy boundary.

Ckc—52 to 60 inches; very pale brown (10YR 8/3) sandy clay loam, very pale brown (10YR 7/3) moist; massive; hard, firm; few calcium carbonate concretions and masses; few fine black concretions; calcareous, moderately alkaline.

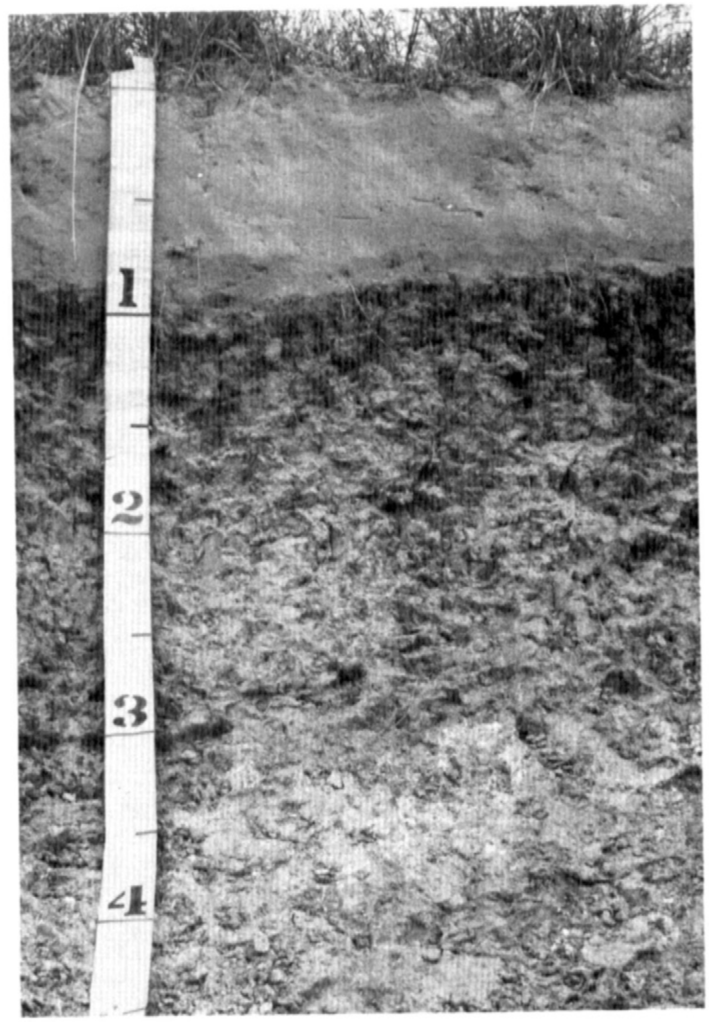


Figure 21.—Papalote fine sandy loam, 0 to 1 percent slopes, has an abrupt wavy boundary between the A and B horizons and calcium carbonate accumulation between depths of 36 and 48 inches. (The scale is in feet.)

The solum ranges in thickness from 40 to 60 inches. Depth to secondary carbonates ranges from 28 to 50 inches.

The A horizon is light brownish gray, grayish brown, brown, gray, or dark gray. It ranges in thickness from about 6 to 16 inches. The texture is fine sandy loam or

loamy fine sand. Reaction is medium acid to mildly alkaline.

Some pedons have an E horizon that is light gray, gray, or white. It ranges in thickness from 1 inch to 6 inches. Reaction and texture are the same as that of the A horizon.

The Bt horizon is very dark grayish brown, very pale brown, light gray, dark brown, brown, dark grayish brown, grayish brown, pale brown, light brownish gray, light yellowish brown, yellowish brown, light brown, or strong brown. Lower values and chromas are in the upper part of the horizon. Mottles range from few to many in shades of brown, red, gray, and yellow. The texture is clay, sandy clay, or clay loam. Reaction is slightly acid to moderately alkaline. Clay content ranges from 35 to 55 percent in the upper 20 inches of the Bt horizon and decreases with depth.

The Bkc horizon is grayish brown, light brownish gray, very pale brown, yellowish brown, yellowish red, pinkish gray, pink, reddish yellow, reddish brown, light brown, brown, strong brown, or pale brown. The texture is sandy clay loam or sandy clay. Reaction is neutral to moderately alkaline and calcareous. Clay content ranges from 30 to 40 percent.

The C horizon has about the same colors as the Bkc horizon, but it also includes white and yellow. The texture is sandy clay loam or sandy clay. Reaction ranges from neutral to moderately alkaline and calcareous or noncalcareous. Calcium carbonate concretions and masses range from none to many.

Sarita Series

The Sarita series consists of deep sandy soils on nearly level to gently undulating uplands and stream terraces. These soils formed in sandy and loamy eolian and alluvial sediments. Slopes range from 0 to 5 percent.

Typical pedon of Sarita fine sand in an area of Sarita-Falfurrias fine sands, 0 to 5 percent slopes; from U.S. Highway 183 in Refugio, 11.3 miles north on U.S. Highway 77, 0.5 mile west on a private ranch road, and 150 feet southwest, in rangeland.

A—0 to 10 inches; light brownish gray (10YR 6/2) fine sand, dark grayish brown (10YR 4/2) moist; single grained; loose; common fine roots; slightly acid; clear smooth boundary.

E—10 to 50 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grained; loose; common fine roots; slightly acid; abrupt smooth boundary.

2Bt1—50 to 54 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; common fine faint and few fine distinct brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure parting to weak fine and medium blocky; hard, friable; few fine roots; thin patchy clay films; neutral; clear smooth boundary.

2Bt2—54 to 62 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; common fine and medium faint and distinct brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium blocky; hard, friable; thin patchy clay films; neutral; gradual smooth boundary.

2BC—62 to 72 inches; light gray (10YR 7/2) fine sandy loam, light brownish gray (10YR 6/2) moist; few fine faint brownish yellow mottles; weak fine and medium subangular blocky structure and weak fine granular; slightly hard, friable; moderately alkaline.

The solum ranges in thickness from 60 to more than 80 inches. Reaction is slightly acid or neutral in the upper part of the solum and slightly acid to moderately alkaline in the lower part.

The A horizon is grayish brown, light brownish gray, pale brown, or light brown. It is 4 to 12 inches thick.

The E horizon is light gray, pale brown, very pale brown, or light brown. It is 30 to 65 inches thick. The texture is fine sand or loamy fine sand.

The 2Bt and 2BC horizons are light gray, light brownish gray, pale brown, very pale brown, or light yellowish brown. Mottles in shades of yellow, brown, and red range from few to many and faint to distinct. Some pedons have grayish mottles. The texture is sandy clay loam or fine sandy loam. The 2BC horizon is noncalcareous or calcareous.

Sinton Series

The Sinton series consists of deep, loamy soils on nearly level flood plains (fig. 22). These soils formed in calcareous, loamy, stratified alluvial sediment. Slopes are 0 to 1 percent.

Typical pedon of Sinton clay loam, occasionally flooded; from U.S. Highway 77 in Woodsboro, 0.8 mile east on Farm Road 136, 6.4 miles south and east on Farm Road 1360, 2.1 miles south on a paved county road, 0.3 mile east on a private ranch road, and 100 feet north, in rangeland.

A1—0 to 11 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate fine and medium subangular blocky structure; very hard, friable; many fine roots; few fine pores; few snail shells and shell fragments; calcareous, moderately alkaline; clear smooth boundary.

A2—11 to 35 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; very hard, friable; common fine roots; common fine pores; few snail shells and shell fragments; common insect tunnels; few thin lenses

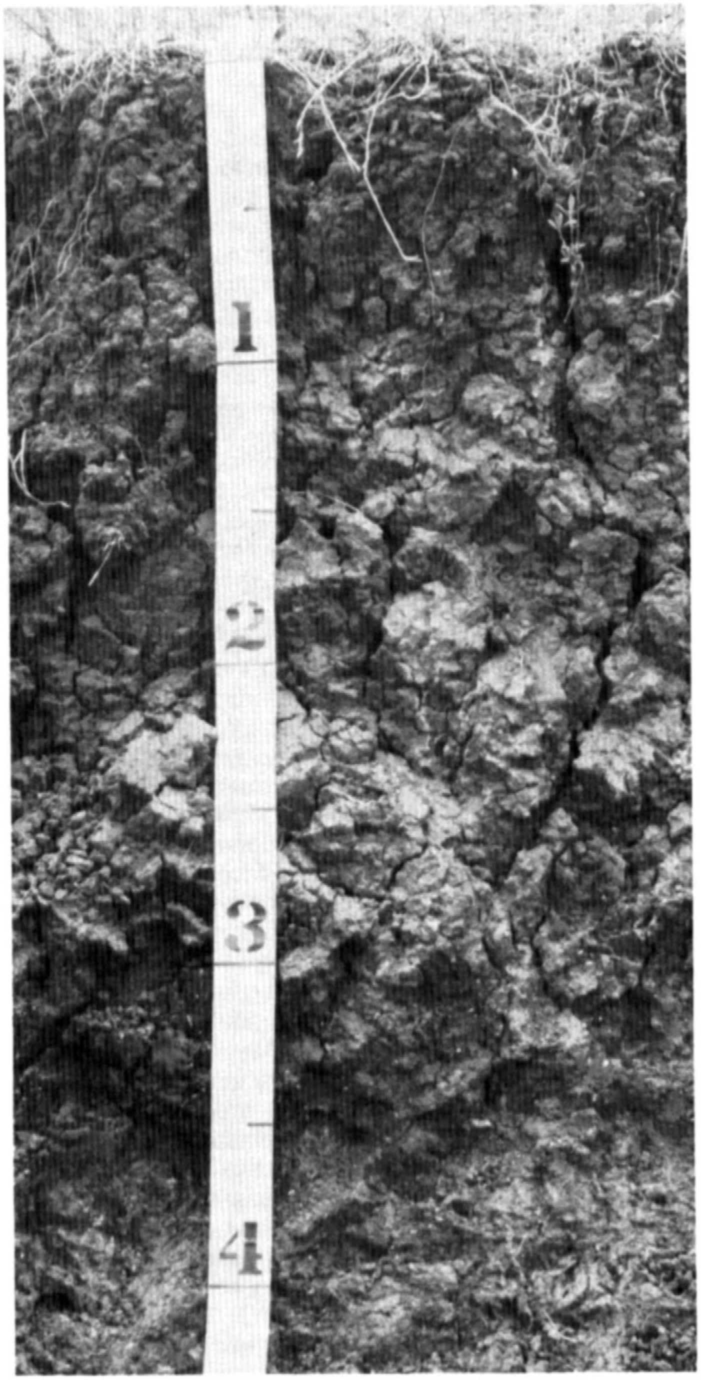


Figure 22.—Sinton clay loam, occasionally flooded, has subangular blocky and blocky structure.

of silt and fine sandy loam in lower part; few films and threads of calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

C1—35 to 60 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; massive; very hard, friable; few fine roots; few fine pores; few snail shells and shell fragments; few bedding planes; few thin lenses of silt and fine sandy loam; few films and threads of calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

C2—60 to 70 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; few snail shells and shell fragments; few bedding planes; few thin lenses of loam; few threads and films of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges in thickness from 20 to 40 inches. Clay content of the control section ranges from 20 to 35 percent. Most pedons contain thin strata of contrasting textures at a depth of 25 to 50 inches. Some pedons contain snail shells and shell fragments throughout the profile. Shell and shell fragment content ranges from none to common. Some pedons are noncalcareous.

The A horizon is very dark gray, very dark grayish brown, dark brown, dark grayish brown, or dark gray. The texture of the 10- to 40-inch control section is loam, clay loam, or sandy clay loam. The A horizon is calcareous or noncalcareous and moderately alkaline.

The C horizon is brown, pale brown, very pale brown, gray, light gray, grayish brown, light brownish gray, or white. The texture is loam, sandy clay loam, fine sandy loam, clay loam, or loamy fine sand that has bedding planes and thin lenses of various textures. Clay content averages between 10 and 35 percent. The C horizon is calcareous and moderately alkaline.

Victine Series

The Victine series consists of deep, clayey soils on nearly level, low coastal plains and terraces. These soils formed in saline, calcareous, clayey marine sediment. Slopes are 0 to 1 percent.

Typical pedon of Victine clay; from U.S. Highway 77 in Refugio, 21.2 miles east on Farm Road 774, 1.4 miles south on Texas Highway 35, and 100 feet west, in rangeland.

Az1—0 to 14 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine angular blocky and subangular blocky structure; hard, firm, plastic and sticky; many fine roots; few fine calcium carbonate concretions and shell fragments; very slightly saline; calcareous, moderately alkaline; gradual wavy boundary.

Az2—14 to 44 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium angular blocky structure forming parallelepipeds

tilted about 30 degrees from horizontal; very hard, very firm, plastic and sticky; common intersecting slickensides; few fine roots; few fine calcium carbonate concretions and shell fragments; slightly saline; calcareous, moderately alkaline; gradual wavy boundary.

Bkyz—44 to 64 inches; gray (10YR 6/1) clay, gray (10YR 5/1) moist; common vertical light gray (10YR 7/1) streaks and splotches; moderate medium angular blocky structure forming parallelepipeds tilted about 30 degrees from horizontal; very hard, very firm, plastic and sticky; common intersecting slickensides; common calcium carbonate concretions and masses; few shell fragments; few fine gypsum crystals; few films and threads of other salts; moderately saline; calcareous, strongly alkaline; gradual wavy boundary.

Ckyz—64 to 72 inches; light gray (10YR 7/1) clay, gray (10YR 6/1) moist; few vertical gray (10YR 5/1) streaks; massive; very hard, very firm, plastic and sticky; common calcium carbonate concretions and masses; common seams and pockets of gypsum crystals; films and threads of other salts; strongly saline; calcareous, strongly alkaline.

The solum ranges in thickness from about 50 to 72 inches. Thickness of the A horizon ranges from about 30 to 50 inches and varies within a pedon, being thinnest on microhighs and thickest in microdepressions. The amplitude of waviness between the A and B horizons ranges from 18 to 40 inches. When the soil is dry, cracks up to 3 inches wide at the surface and becoming narrower with depth extend into the C horizon. Some pedons in microdepressions are noncalcareous to a depth of about 18 inches. Reaction is moderately alkaline or strongly alkaline. The soils are calcareous throughout in more than half the pedon. Salinity increases with depth and ranges from 1 to 4 millimhos per centimeter in the upper 12 inches of the A horizon, 4 to 16 millimhos per centimeter in the lower part, and 8 to 35 millimhos per centimeter in the B and C horizons. Clay content in the control section ranges from 45 to 60 percent.

The A horizon is dark gray or very dark gray. The B horizon is grayish brown, light brownish gray, pale brown, or gray. The C horizon is light gray, light brownish gray, pale brown, very pale brown, or white. The texture of the B and C horizons is clay or silty clay.

Victoria Series

The Victoria series consists of deep, clayey soils on nearly level to gently sloping uplands. These soils formed in calcareous, clayey marine sediment. Slopes range from 0 to 3 percent.

Typical pedon of Victoria clay, 0 to 1 percent slopes; from U.S. Highway 183 in Refugio, 20 miles north of Refugio on U.S. Highway 77, 1.9 miles east on Texas Highway 239, 3.3 miles south and east on a private ranch road, and 75 feet south, in a microlow in rangeland.

A—0 to 9 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine subangular blocky structure; hard, firm, plastic and sticky; common fine roots; surface cracks 0.5 to 0.75 inch wide; few shell fragments; few fine calcium carbonate concretions; pressure faces in lower part; calcareous, moderately alkaline; gradual wavy boundary.

Ak1—9 to 28 inches; black (10YR 2/1) clay, black (10YR 2/1) moist; moderate fine and medium angular and subangular blocky structure; parallelepipeds tilted about 30 degrees from horizontal; very hard, very firm, plastic and sticky; common fine roots; cracks 0.5 inch wide; few shell fragments; few fine calcium carbonate concretions; shiny pressure faces on ped surfaces; few slickensides in lower 6 inches; calcareous, moderately alkaline; gradual wavy boundary.

Ak2—28 to 45 inches; black (10YR 2/1) clay, black (10YR 2/1) moist; moderate fine and medium angular and subangular blocky structure; distinct parallelepipeds tilted about 35 degrees from horizontal; very hard, very firm, plastic and sticky; common fine and few medium roots; cracks about 0.5 inch wide, narrower with depth; few shell fragments; few fine calcium carbonate concretions and masses; common pressure faces in upper part; common intersecting slickensides in lower part; calcareous, moderately alkaline; gradual wavy boundary.

Bky—45 to 72 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common streaks and splotches of dark gray (10YR 4/1); moderate medium angular blocky structure; distinct parallelepipeds tilted about 35 degrees from horizontal; very hard, very firm, plastic and sticky; few fine roots; few fine cracks; few fine calcium carbonate concretions and masses; few seams and pockets of gypsum crystals in lower part; intersecting slickensides; slightly saline; calcareous, moderately alkaline; gradual wavy boundary.

Ckyz—72 to 94 inches; light gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; few gray (10YR 6/1) streaks; few medium and common fine distinct yellow (10YR 7/6) mottles; weak fine subangular blocky structure parting to massive; very hard, very firm, plastic and sticky; few fine calcium carbonate concretions and masses; few seams and pockets of gypsum crystals and other salts; moderately saline; calcareous, moderately alkaline.

The solum ranges in thickness from about 50 to 72 inches. Thickness of the A horizon ranges from about 30 to 50 inches in more than half of a pedon and varies

within a pedon, being thinnest in microhighs and thickest in microlows. The amplitude of waviness between the the A and B horizons ranges from 21 to 40 inches. When the soil is dry, cracks up to 3 inches wide at the surface and becoming narrower with depth extend into the C horizon. The soil is calcareous throughout in more than half the pedon. Some pedons are noncalcareous to a depth of about 18 inches in microlows. Reaction is moderately alkaline or strongly alkaline. Salinity increases with depth, and electrical conductivity ranges from 0.5 to 4 millimhos per centimeter in the A horizon, 1 to 8 millimhos per centimeter in the B horizon, and 4 to 16 millimhos per centimeter in the C horizon. Clay content in the control section ranges from 45 to 60 percent.

The A horizon is black, dark gray, or very dark gray. The B horizon is grayish brown, light brownish gray, gray, or pale brown. The C horizon is light gray, light brownish gray, pale brown, very pale brown, or white. The texture is clay or silty clay throughout.

Vidauri Series

The Vidauri series consists of deep, loamy soils on nearly level to slightly depressional uplands (fig. 23). These soils formed in clayey and loamy sediments. Slopes are 0 to 1 percent.

Typical pedon of Vidauri fine sandy loam; from U.S. Highway 183 in Refugio, 11.3 miles north on U.S. Highway 77, 6.4 miles northwest on a private ranch road to Welder west ranch headquarters, 1.1 mile north on a private ranch road to a windmill, 0.9 mile northwest from windmill on private ranch road, and 100 feet north, in rangeland.

A—0 to 6 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine faint yellowish brown mottles; massive; very hard, friable; common fine roots; few insect tunnels; slightly acid; abrupt wavy boundary.

Btg1—6 to 13 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; common fine faint brownish yellow and yellowish brown mottles; moderate medium blocky structure; extremely hard, extremely firm, few fine roots; continuous clay films; pressure faces; common cracks filled with surface material; slightly acid; clear wavy boundary.

Btg2—13 to 21 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common medium distinct yellow (10YR 7/8) and yellowish brown (10YR 5/8) mottles; moderate coarse blocky structure; extremely hard, extremely firm; few fine roots; discontinuous clay films; pressure faces; cracks filled with material from overlying horizons; neutral; gradual wavy boundary.

Btg3—21 to 31 inches; light brownish gray (10YR 6/2) sandy clay, grayish brown (10YR 5/2) moist; few fine and medium distinct yellow (10YR 7/8) and yellowish brown (10YR 5/8) mottles; moderate medium blocky structure; extremely hard, extremely firm; few fine roots; discontinuous clay films; pressure faces; few vertical streaks of dark material; moderately alkaline; gradual wavy boundary.

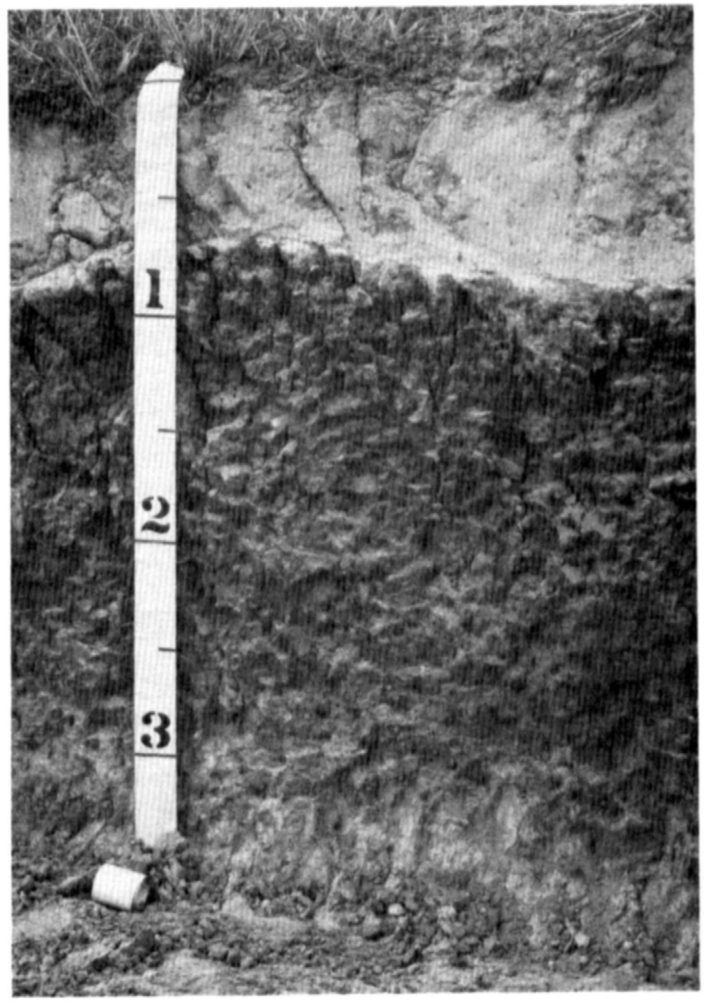


Figure 23.—Vidauri fine sandy loam has an abrupt wavy boundary between the A and B horizons.

Bk1—31 to 40 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; few fine faint yellow mottles; weak fine subangular blocky structure; very hard, very firm; few fine roots; few dark streaks in upper part; few fine calcium carbonate concretions and masses; noncalcareous, moderately alkaline; diffuse wavy boundary.

Bk2—40 to 66 inches; very pale brown (10YR 8/3) sandy clay loam, very pale brown (10YR 7/3) moist; few fine faint yellow mottles and few fine distinct brown mottles; weak very fine subangular blocky structure; very hard, very firm, few fine calcium

carbonate concretions and masses; noncalcareous, moderately alkaline.

The solum ranges in thickness from 60 to more than 80 inches. The soil cracks when dry, but cracks rarely extend through the A horizon to the surface. Some pedons have a discontinuous E horizon.

The A horizon is light gray, gray, light brownish gray, or grayish brown. It is less than 10 inches thick in more than 50 percent of any pedon, but ranges up to 18 inches thick in parts of some pedons. When dry, the A horizon is massive and very hard or extremely hard. Reaction ranges from strongly acid to slightly acid.

Some pedons have an E horizon that has higher value than the A horizon and generally occurs in subsoil microdepressions where the A horizon is the thickest.

The Btg horizon is light gray, gray, dark gray, light brownish gray, grayish brown, or dark grayish brown. Mottles in shades of yellow and brown range from few to many and are fine or medium. The texture is clay, sandy clay or clay loam. Clay content in the control section ranges from 35 to 55 percent. Some pedons have dark gray coatings on ped surfaces. Reaction is medium acid or slightly acid in the upper part of the horizon and slightly acid to moderately alkaline in the lower part.

The Bk horizon is very pale brown, pale brown, light yellowish brown, light brownish gray, light gray, or white. Mottles in shades of yellow and brown range from none to few and are fine or medium. The texture is sandy clay loam or sandy clay. Calcium carbonate concretions range from none to common. The matrix in most pedons is noncalcareous. Reaction is mildly alkaline or moderately alkaline.

Wyick Series

The Wyick series consists of moderately deep, loamy soils on nearly level uplands. These soils formed in calcareous, clayey and loamy sediments. Slopes range from 0 to 2 percent.

Typical pedon of Wyick fine sandy loam; from U.S. Highway 183 in Refugio, 11.3 miles north on U.S. Highway 77 to a private ranch road at Welder ranch headquarters, 6.4 miles northwest on a private ranch road from Welder ranch headquarters to Welder west ranch headquarters, 1.9 miles southwest of buildings on a private ranch road, and 100 feet south, in rangeland.

A—0 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable, nonplastic and nonsticky; common very fine and fine roots; common fine and very fine pores; few insect tunnels; common fine faint organic stains; slightly acid; abrupt wavy boundary.

Btcg1—10 to 21 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common fine distinct yellowish brown (10YR 5/6) mottles and few fine faint gray mottles; moderate medium and coarse prismatic structure parting to moderate medium and coarse blocky; extremely hard, very firm, very plastic and very sticky; common fine roots; few fine pores; few vertical cracks filled with fine sandy loam material; thin continuous clay films on ped surfaces; few fine black concretions; slightly acid; gradual wavy boundary.

Btcg2—21 to 32 inches; light gray (10YR 6/1) clay loam, gray (10YR 5/1) moist; common fine distinct yellowish brown (10YR 5/6) mottles and few fine faint gray mottles; moderate coarse prismatic structure parting to moderate medium and coarse blocky; extremely hard, very firm, plastic and sticky; common fine roots; few fine pores; few vertical cracks filled with fine sandy loam material; thin discontinuous clay films on ped surfaces; few fine black concretions; moderately alkaline; gradual wavy boundary.

BCkc—32 to 38 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; moderate medium subangular blocky structure; very hard, very firm, plastic and sticky; few fine roots; few fine black concretions; few fine concretions and soft powdery forms of calcium carbonate; calcareous, moderately alkaline, gradual wavy boundary.

Ckc—38 to 60 inches; light gray (2.5Y 7/2) sandy clay loam, light brownish gray (2.5Y 6/2) moist; massive; very hard, very firm, plastic and sticky; few fine black concretions; about 5 percent, by volume, concretions and soft powdery forms of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 30 to 40 inches to unconsolidated sediment. Depth to secondary forms of calcium carbonate range from 28 to 36 inches. Clay content in the upper 20 inches of the Bt horizon ranges from 38 to 50 percent. COLE ranges from 0.03 to 0.09.

The A horizon is dark grayish brown, grayish brown, or light brownish gray. It is 5 to 11 inches thick. Reaction is slightly acid or neutral. Some pedons have an E horizon 1 inch to 2 inches thick that is light brownish gray or light gray.

The Btcg horizon is dark grayish brown, dark gray, grayish brown, gray, light gray, or light brownish gray. Mottles in shades of yellow, brown, and gray range from few to common. The texture is clay, sandy clay, clay loam, or sandy clay loam. Reaction ranges from slightly acid to neutral in the upper part of the Btg horizon and from slightly acid to moderately alkaline in the lower part. Evidence of cracking in the form of vertical streaks filled with surface material range from none to common. Cracks at a depth of 20 inches are 0.1 to 0.4 inch wide when the soil is dry. They extend from the top of the Btg horizon into the upper part of the BC horizon. Cracks do not extend through the A horizon to the surface. Black concretions and weakly cemented masses, 1 millimeter

to 5 millimeters in diameter, range from none to common.

The BC horizon is pale brown, light brownish gray, light gray, or very pale brown. The texture is sandy clay loam, sandy clay, or clay. Reaction is mildly alkaline or moderately alkaline. The matrix is noncalcareous or calcareous. Some pedons have cracks in the upper 1 inch or 2 inches of this horizon. Black concretions and weakly cemented masses range from few to common. Concretions and soft powdery forms of calcium carbonate make up to 10 percent, by volume.

The C horizon is pale brown, light gray, white, or very pale brown. The texture is sandy clay loam or sandy clay. Reaction is moderately alkaline. The matrix is calcareous or noncalcareous. Black concretions and weakly cemented masses range from few to common. Concretions and soft powdery forms of calcium carbonate make up 0 to 15 percent, by volume.

Formation of the Soils

In this section the factors of soil formation are discussed and related to the soils in Refugio County. In addition, the processes of soil formation and soil horizon differentiation are described.

Factors of Soil Formation

Soil is produced by the action and interaction of soil-forming factors on material deposited or accumulated by geologic processes. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the soil material accumulated and existed since accumulation, the plant and animal life on and in the soil, the relief, and the length of time these forces have acted on the soil material.

Climate and living organisms act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and living organisms are conditioned by relief. The parent material also affects the kind of profile that can be formed. Finally, time is needed to change the parent material into a soil profile. It may be long or short, but some time is always needed for distinct horizons to develop.

The interaction among the five factors is complex and continuous and so interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Each factor is discussed separately, however, and the probable effects of each are indicated.

Parent Material

Parent material is the unconsolidated mass from which a soil forms. It determines the chemical and mineral composition of the soil. The soils of Refugio County were formed in loamy and clayey alluvium deposited by ancient rivers and streams or in marine sediment related physiographically to the present Gulf of Mexico. The Faddin, Inez, and Papalote soils formed in loamy and clayey alluvium and the Narta, Orelia, Victine, and Victoria soils formed in marine sediment. Terrace or windblown sands, such as the Falfurrias, Galveston, Mustang, and Sarita soils are in some areas. Some of these areas have been reworked or modified by wind action. The geology of the parent material is described in more detail in the "Geology" section.

Climate

Precipitation, temperature, humidity, and wind have had a major effect on the formation of the soils of Refugio County.

Climate directly affects soil formation through its influence on weathering, leaching of carbonates, downward movement of clay particles, reduction and movement of iron, and rate of erosion. Climate also determines the kind and amount of plant and animal life that exists on and in the soil.

The climate of Refugio County is humid subtropical and is uniform throughout the county. Timely rainfall, mild year-round temperatures, high humidity that tends to lessen moisture loss by evaporation and transpiration, and moderate winds that cool in summer and warm in winter allow growth of some plants in all seasons of the year. The moderate climate of Refugio County has promoted moderately rapid soil formation.

Plant and Animal Life

Plants, micro-organisms, and other forms of plant and animal life living on and in the soil contribute greatly to the soil-forming process. They contribute organic matter, help decompose plant residue, influence the soil chemistry, and aid in development of soil structure. The long growing season produces large quantities of vegetative residue with a correspondingly high level of organic matter. Gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and development in structure and porosity are some of the changes caused by plant and animal life.

Prairie grasses were the dominant native vegetation in most of the county. The Faddin, Victine, Vidauri, and Wyick soils formed under this grassland prairie. They have a dark color surface layer that contains appreciable amounts of organic matter. In some parts of the county, however, the native vegetation was dominantly woody plants. The Inez and Papalote soils formed under the woody plants and have a lighter color surface layer and less organic matter than the soils that formed under prairie vegetation.

Man has had an important effect on the formation and the rate of formation of some soils in Refugio County. He

has installed drainage systems on some soils, protected others from flooding, introduced new plant species, and added fertilizers. These actions have a definite influence on soil genesis; however, the effects may not be apparent for a long time.

Relief

Relief affects soil formation through its influence on drainage, runoff, erosion, plant cover, and soil temperature.

Most soils in the county have slow or very slow runoff because of the nearly level topography and the lack of well defined natural flow channels. When the percolation rate is slow or very slow because of permeability characteristics, drainage is a significant problem.

Soil profile development depends on the amount of moisture and the depth to which moisture penetrates. Nearly level to slightly concave soils, such as Copano, Inez, Narta, Orelia, and Vidauri, generally have a well developed profile.

Relief also affects the kind and amount of vegetation on a soil. North- and east-facing slopes generally receive less direct sunlight than south- or west-facing slopes, and as a result they are slightly cooler and lose less moisture. Vegetation is generally more dense on the north- and east-facing slopes.

Time

A great length of time is generally required for the formation of soils that have distinct horizons. The degree of formation in the profile is determined by the length of time that the parent material has been in place.

Aging causes calcium carbonate to leach from the upper horizons to the lower horizons where it is deposited in the form of soft masses or concretions. Soils, such as Orelia, Papalote, and Wyick, have a noticeable accumulation of calcium carbonate in the lower horizons. These soils are considered old. Falfurrias, Galveston, Mustang, and Odem are young soils. They developed in wind-blown deposits, beach deposits, and recent alluvium respectively and have had little time to develop a well defined profile.

Geology

Prepared by Saul Aronow, Department of Geology, Lamar University, Beaumont, Texas.

Refugio County is in the West Gulf Coastal Plain geomorphic region in which the surface formations and sediment dip Gulfward *(8)*. The geology of the area has been depicted on recent geologic maps *(5, 9, 18)* and discussed in a report *(13)*. The General Soil Map can serve as an approximate guide to the geology of the county.

The surface sediment of the county can be divided into two major groups according to age: Holocene, probably less than 3,500 years old, and Pleistocene, up to several hundred thousand years old. The soils of the Victoria-Edroy-Orelia, Papalote-Orelia, and Faddin-Wyick-Vidauri general soil map units have Pleistocene sediment as their parent material. These soils are on uplands. The soils of the Aransas-Sinton-Odem map unit and the Aransas part of the Aransas-Victine-Narta map unit, formed in Holocene sediment. These soils are on coastal flood plains. The Victine and Narta soils in the Aransas-Victine-Narta map unit developed in saline, poorly drained Pleistocene material. The soils of the Dietrich-Galveston-Mustang map unit represent a Holocene eolian re-working of Pleistocene littoral sands. A third, but minor, group is made up of the few terraces along the San Antonio and Mission Rivers. These terraces are intermediate in elevation between the fluvial Holocene bottom lands and adjacent uplands.

Pleistocene Formations

The Pleistocene sediment is divided *(18)* into the Lissie and Beaumont Formations. The Lissie Formation is older and more inland than the Beaumont Formation. The outcrop areas of these formations sub-parallel the margins of the Gulf of Mexico. The Victine and Narta soils are on the Beaumont Formation, and most of the soils of the Dietrich-Galveston-Mustang general soil map unit are probably on the Beaumont-age Ingleside barrier or strandplain deposits.

The Lissie Formation includes the area north of Refugio and most of the area north and west of U.S. Highway 77. South of Refugio, the Lissie-Beaumont geologic boundary basically conforms to the southeast margins of the Papalote-Orelia general soil map unit. In this area the adjacent, interpenetrating parts of the Victoria-Edroy-Orelia map unit are also on the Lissie Formation. Southeast of the Lissie Formation is the outcrop area of the Beaumont Formation. The soils of the Victoria-Edroy-Orelia map unit and accompanying finger-like extensions of the soils of the Papalote-Orelia and Faddin-Wyick-Vidauri map units are on the Beaumont Formation. By contrast, most of the Lissie Formation is capped by the soils of the Papalote-Orelia and Faddin-Wyick-Vidauri map units.

Both formations are probably of fluvial and deltaic origin. The general southeasterly and southerly orientation of the soils on the Pleistocene uplands display a relict depositional pattern with varying degrees of preservation. Based on the upstream headings of the elongate patterns, it is likely that sediments were deposited by several rivers that preceded modern streams, including paleo-San Antonio, paleo-Mission, and paleo-Aransas Rivers.

Modern analogies to the deposition of the Lissie and Beaumont sediment exist on a larger scale in the form of the Holocene combined alluvial plains of the Brazos and Colorado Rivers to the northeast, and the alluvial plain (delta) of the Rio Grande to the south. These rivers were

not confined to narrow, upland alluvial valleys but shifted laterally while they prograded over broad, estuarine and shallow shelf surfaces.

The texture of the parent material, the smaller relict channel patterns, and the over-all larger patterns suggest that the clayey sediment underlying the soils of the Victoria-Edroy-Orelia map unit are of flood basin, deltaic interdistributary, and possibly coastal marsh, lagoonal, or estuarine origin. The sandier sediment underlying the soils of the Papalote-Orelia and Faddin-Wyick-Vidauri map units indicates that these soils are of meander ridge and deltaic distributary origin *(5, 9)*.

The Victoria, Monteola, and Victine soils are Vertisols. These soils are mostly on thick, clayey parent material of flood basin or deltaic interdistributary origin. The Copano, Faddin, Inez, Vidauri, and Wyick soils have mostly clay loam, sandy clay loam, and sandy clay substrates. These soils may be situated on parent material of fluvial meander ridge or deltaic distributary origin. In either of these fluvial and deltaic environments, the more clayey and silty substrates of these and other soils may be flanking levee deposits or subadjacent crevasse splay deposits resting upon slightly older flood basin or interdistributary clays.

Because the soil profile is sampled to a depth of only about 6 feet, more specific identification of parent material in terms of environments of deposition is difficult. The shallow material is within the zone of influence of normal fluvial upward fining sequences (e.g., sands below and siltier and clayier material near the surface) and of the re-working of originally fluvial and deltaic sediments by wind, surface runoff, mass wasting, plants, and animals.

The discrimination of meander-ridge and distributary versus flood basin and interdistributary patterns, especially on the Beaumont surface, is considerably clearer in counties to the northeast of Refugio County. A process common in both areas tends to obscure the distinctions between the two patterns. The process was the partial or complete covering of meander-ridge and distributary patterns by later overbank muds of flood basin and interdistributary origins as channels shifted laterally. Despite this recurrent process, the surface of the counties to the north display many more clearly defined meandering and straight channels.

The main reason for the difference, however, seems to be caused by increasing aridity, higher evaporation rates, and less persistent and less generous plant cover to the southwest along the Gulf Coastal Plain. This enables the wind to deflate the surface, redeposit the coarser soil and sediment fractions, and remove the finer fractions from the area. Wind effects of the past have probably been greater than at present. Within Refugio County, the difference in the degree of preservation of meander patterns of streams along the Holocene bottom lands and the Beaumont and Lissie Formations can easily be seen. This difference can be ascribed both to a longer period of time for the deterioration of the uplands and to probable increased aridity in the past.

The effects of the wind in modifying the original depositional patterns is shown by the depressions of deflationary origin, small and large; pimple mounds; thick-surfaced soils that have hummocky dune topography; and the loamy and sandy surface of many soils.

Circular to elliptical depressions of various sizes dot the surface of the county. Many are mapped as Edroy clay, depressional. Explanations other than wind deflation, or blowout origin, such as subsurface solution and piping, do not seem applicable here. Most of the Edroy series was developed on meander-ridge or distributary surfaces. The surface clay linings of these depressions are probably the result of a recent filling phase by surface waters as opposed to deflationary activity of the past. The Edroy soils in shallow, discontinuous channels suggests cutting and filling of channels by laterally moving eolian sediment and later water-transported fillings.

The smaller deflation hollows do not have a depositional rim or lee-side sediment derived from the hollow. The contents of the hollows were probably scattered by the wind and incorporated in the adjacent soils and pimple mounds.

The larger depressions in Refugio County are Willow Lake, North and South Nicholas Lakes, and the now dry Sharps Lake and Ninemile Flat. Some of these depressions are examples of South Texas "clam-shaped" and "heart-shaped" lakes. The shapes of these lakes was determined by bimodal wind directions. The beaches and associated dunes were localized along their southern shores *(11, 12)*.

Pimple mounds in the county are another landform of at least partly eolian origin. They are about 20 to 150 feet in diameter and are generally less than three feet in height. The mounds in the Gulf Coast region range from about the vicinity of Corpus Christi into east Texas. They extend as far north as Minnesota, east to the Mississippi River, and west into Colorado, California, Washington, and Oregon. In Refugio County, the mounds are close to their southernmost Gulf Coast extent. They are more abundant on Pleistocene surfaces to the northeast. Small numbers of pimple mounds are on the Wyick, Vidauri, and Dietrich soils. Most of the relief of the mound can be attributed to an increase in the thickness of the surface layer and of the subsurface layer, if present.

Theories of the origin of pimple mounds include their formation as residual patches left after sheetflood erosion, or deflation of the surface by the wind; accumulations of wind-transported sand, silt, or clay pellets or chips around clumps of vegetation; wind accumulations whose sites were started by, or later topographically enhanced by, erosional processes; and the "fluffing up" or decreasing bulk densities of soil

material by burrowing animals, or the lateral and centripetal transport of surface material by animals *(6)*.

The Sarita and Falfurrias soils are deep and sandy. They have a dune-like hummocky surface as a result of the wind.

Most of the soils on uplands that have a comparatively shallow fine sandy loam and loamy fine sand surface have abrupt contacts with their more clayey substrates. Surface soil textures on uplands are mainly clays or fine sandy loams and loamy fine sands. The upper layers of the sandy soils are the same or are similar despite a variety of substrates, because of the lateral movement of soil material by the wind during pedogenesis and the very efficient sorting action of the wind in removing finer clay components. The many abrupt contacts of the sandy surface with the more clayey substrates suggests interruptions of pedogenesis by the wind.

An anomalous feature occurs in the Lissie outcrop area. The three caliche pits that are about 2 to 3 miles almost due west of the juncture of Medio and Blanco Creeks, on the north side of Medio Creek are over 15 feet thick. These areas were not included in the profiles of the soils in the vicinity. Caliche elsewhere in the county also has not been described. The caliche seems to be similar to that exposed in the older Goliad Formation in Goliad County. A geologic cross section shows that the top of the Goliad Formation is about 250 feet below the surface in the area of the pits *(13)*. The caliche may be exposures of a previously unrecognized topographic high on the Goliad surface or a fault-controlled displacement of the Goliad Formation that was buried by the later Lissie sediment. Equally likely is the possibility that this is an unusual and highly localized caliche accumulation of Lissie age.

The small area of the Dietrich-Galveston-Mustang general soil map unit in the extreme eastern part of the county is also of Pleistocene age. The Mustang and Galveston soils have been recently disturbed by the wind; the more mature Dietrich soil has been less disturbed. These soils developed on sands of barrier island or strandplain origin. The major difference between these two origins is the presence of a lagoon landward of a barrier and its absence landward of a strandplain. In the case of a barrier origin, some of the clays of the Victoria-Edroy-Orelia map unit would be from the lagoon.

The Pleistocene Ingleside Formation extends along the Gulf Coast from the south side of Corpus Christi Bay to western Louisiana. Its age and its relationship to the Beaumont Formation has been in dispute, but in Refugio County it is either an integral part of the Beaumont Formation, or it is slightly younger *(3, 10, 19)*.

The deposition of both the Lissie and Beaumont Formations was probably controlled by glacially induced changes in sea level. During the times of major continental glacier formation and advance, sea level dropped as water from the oceans was incorporated into land-based ice. Sea level was about 260 to 450 feet below its present level. During the interglacials, sea level rose to levels similar to those of the present, and sediment was deposited by rivers, waves, and currents. The sediment replaced and extended areas eroded during the times of lower sea level. The Lissie and Beaumont Formations were deposited during the times of higher sea level and represent a fluvial and deltaic progradation of the coast after the return of high sea levels. The Gulf Coast region is continually subsiding and tilting to the Gulf. The sea or bay margins of the Beaumont Formation are near sea level. The Narta and Victine soils are in this area and are saline and poorly drained.

The age of the Lissie Formation is not known, but it is older than the Beaumont Formation. The Beaumont Formation is from 25,000 to 30,000 years before the present to over 70,000 years before the present.

While the Lissie and Beaumont Formations, from a geologic standpoint, are useful and valid concepts, more detailed work in the Pleistocene of the Gulf Coast may disclose that more than two high sea level stands are represented by these formations.

River Terraces

A few river terraces, intermediate in elevation between the adjacent uplands and the Holocene fluvial bottom lands, are along the San Antonio and Mission Rivers *(18)*.

The terraces along the San Antonio River are well defined. They are west of U.S. Highway 77 and north of State Highway 239. The flanking upland is the Beaumont surface. The wind-disturbed Falfurrias and Sarita soils are the major surface material. These soils probably derived from the underlying sandy fluvial sediment.

The terraces along the Mission River are in the vicinity of where Medio and Blanco Creeks join to form the Mission River. They are poorly defined. The lower levels merge with the bottom lands, and the upper levels merge with the adjacent Lissie surface. The Papalote, Falfurrias, and Sarita soils on uplands and the Odem on flood plains are in this area.

The place of the river terraces in the Pleistocene stratigraphic sequence is uncertain. The San Antonio River terraces may have been deposited as that stream deepened its channel in response to the last great post-Beaumont lowering of sea level, perhaps more than 17,000 to 19,000 years ago, and left hanging as the channel was cut to even lower levels. The Mission River terraces may have a similar history, or they may be correlative with the Beaumont surface farther downstream.

Holocene Sediment

Rather arbitrarily, the Holocene has been defined as beginning about 10,000 years ago *(4)*, a time not

especially relevant to the surface sediments in the Texas Gulf Coast. The surface of the most recent sediment graded to and adjusted to the present sea level within the past 3,500 years. Sea level has risen slowly since its great drop about 18,000 years ago. During this rise, the many stream valleys were gradually drowned along with any attendant coastal features. Since sea level stabilized, the streams have been alluviating or backfilling the previously submerged valleys. The rounded bays and estuaries probably acquired their present forms as the result of erosion and deposition only since the present stand of sea level.

Of the three major streams in or bordering Refugio County, only the combined San Antonio and Guadalupe Rivers have built an actively advancing delta. The Aransas and Mission Rivers have deposited only poorly defined, highly tidal estuarine deltas that show no signs of actively prograding into Mission Bay or the larger Copano Bay.

Despite the varieties of deltaic subenvironments mapped, most of the surface sediment of the San Antonio-Guadalupe delta are clays and silty clays *(7)*. The Aransas soils make up the delta in Refugio County. Upstream, in the fluvial parts of the San Antonio River, the more loamy Sinton soils begin to phase in. The Sinton soils are on the point bar and levee deposits, and the Aransas soils are on the flood basin deposits.

The deposits of the Mission and Aransas Rivers are influenced along the bays by tidal effects. The clayey Barrada and Aransas soils are dominate in this area. Upstream, these soils are gradually replaced by the loamier and sandier Sinton and Odem soils. The shape of soil delineations and the texture of the Odem soils strongly suggest eolian reworking. Towards the northern edge of the county, the sorting and transporting effects of wind become more obvious with the increasing appearance of the hummocky dune topography of the Falfurrias and Sarita soils both on the flood plains and along the adjacent highlands.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels, i.e., clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). The volume of soft soil decreases excessively under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly

continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, such as fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil restrict the growth of some plants.

Excess sodium (in tables). Excess exchangeable sodium is in the soil. The resulting poor physical properties restrict the growth of plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The movement of water into the soil is rapid.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant that is not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B

horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the plants that are the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). In these areas, surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). There is a shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). There is a risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of course grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. This contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data recorded in the period 1951-80 at Refugio, Texas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	65.9	43.0	54.5	85	19	213	2.13	0.57	3.37	4	.0
February---	69.6	45.6	57.6	87	23	237	2.28	0.54	3.65	4	.3
March------	76.0	53.0	64.5	91	29	455	1.29	0.26	2.08	3	.0
April------	81.2	61.0	71.1	93	37	633	2.55	0.72	4.02	3	.0
May--------	86.3	67.0	76.7	95	49	828	4.40	1.29	6.90	5	.0
June-------	91.2	71.8	81.5	98	59	945	3.94	0.64	6.43	4	.0
July-------	94.0	73.6	83.8	100	67	1,048	2.66	0.54	4.31	4	.0
August-----	94.3	72.8	83.6	101	66	1,042	3.61	0.99	5.71	5	.0
September--	90.6	69.8	80.2	99	53	906	7.75	2.65	11.95	7	.0
October----	84.4	60.4	72.4	94	40	694	3.97	1.08	6.31	5	.0
November---	75.7	51.9	63.8	90	27	423	2.27	0.89	3.42	4	.0
December---	69.5	46.0	57.8	85	22	262	1.92	0.48	3.05	4	.0
Yearly:											
Average--	81.6	59.7	70.6	---	---	---	---	---	---	---	---
Extreme--	---	---	---	102	18	---	---	---	---	---	---
Total----	---	---	---	---	---	7.686	38.77	29.09	48.41	52	.3

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 °F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data recorded in the period 1951-80 at Refugio, Texas]

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	February 16	March 2	March 22
2 years in 10 later than--	February 6	February 23	March 14
5 years in 10 later than--	January 19	February 9	February 26
First freezing temperature in fall:			
1 year in 10 earlier than--	December 15	November 21	November 6
2 years in 10 earlier than--	December 25	November 30	November 15
5 years in 10 earlier than--	January 14	December 17	December 1

TABLE 3.--GROWING SEASON

[Data recorded in the period 1951-80 at Refugio, Texas]

Probability	Daily minimum temperature		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	321	283	254
8 years in 10	331	292	262
5 years in 10	>365	310	277
2 years in 10	>365	329	293
1 year in 10	>365	338	301

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ac	Aransas clay, occasionally flooded	4,745	1.0
Af	Aransas clay, frequently flooded	7,635	1.5
As	Aransas clay, saline, frequently flooded	13,985	2.8
Ba	Barrada clay	2,145	0.4
Co	Copano fine sandy loam	6,170	1.2
Dt	Dietrich loamy fine sand	1,390	0.3
Ec	Edroy clay	31,255	6.3
Ed	Edroy clay, depressional	11,610	2.3
Fd	Faddin fine sandy loam	14,615	3.0
FfC	Falfurrias fine sand, 0 to 5 percent slopes	1,200	0.2
GmB	Galveston-Mustang fine sands, 0 to 3 percent slopes	1,370	0.3
In	Inez fine sandy loam	7,490	1.5
MoC	Monteola clay, 3 to 5 percent slopes	2,515	0.5
MoD4	Monteola clay, 5 to 8 percent slopes, gullied	1,740	0.4
Na	Narta fine sandy loam	11,945	2.4
Od	Odem fine sandy loam, occasionally flooded	3,045	0.6
Or	Orelia fine sandy loam	64,930	13.2
PaB	Papalote loamy fine sand, 0 to 3 percent slopes	19,850	4.0
PtA	Papalote fine sandy loam, 0 to 1 percent slopes	38,870	7.9
PtB	Papalote fine sandy loam, 1 to 3 percent slopes	7,910	1.6
PtC	Papalote fine sandy loam, 3 to 5 percent slopes	2,930	0.6
SfC	Sarita-Falfurrias fine sands, 0 to 5 percent slopes	5,520	1.1
Sn	Sinton clay loam, occasionally flooded	5,240	1.1
St	Sinton clay loam, frequently flooded	2,755	0.6
Va	Victine clay	10,265	2.1
VcA	Victoria clay, 0 to 1 percent slopes	159,320	32.3
VcB	Victoria clay, 1 to 3 percent slopes	6,220	1.3
Vd	Victoria clay, depressional	30,440	6.2
Vr	Vidauri fine sandy loam	8,265	1.7
Wy	Wyick fine sandy loam	7,980	1.6
	Total Land Area	493,350	100.0
	Water	22,912	---
	Total Area of County	516,262	---

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Land capability	Cotton lint	Grain sorghum	Corn	Pasture
		Lbs	Bu	Bu	AUM*
Ac------------------------ Aransas	IIIw	450	55	40	5.0
Af------------------------ Aransas	Vw	---	---	---	5.0
As------------------------ Aransas	VIw	---	---	---	---
Ba------------------------ Barrada	VIIIs	---	---	---	---
Co------------------------ Copano	IIIw	250	45	30	5.0
Dt------------------------ Dietrich	IIIw	---	---	---	3.0
Ec------------------------ Edroy	IVw	300	35	30	4.0
Ed------------------------ Edroy	Vw	---	---	---	---
Fd------------------------ Faddin	IIw	300	55	45	7.0
FfC----------------------- Falfurrias	VIIe	---	---	---	---
GmB----------------------- Galveston-Mustang	VIe	---	---	---	3.0
In------------------------ Inez	IIIw	300	60	50	6.0
MoC----------------------- Monteola	IIIe	300	40	30	3.0
MoD4---------------------- Monteola	VIe	---	---	---	2.5
Na------------------------ Narta	VIs	---	---	---	---
Od------------------------ Odem	IIw	400	45	35	4.0
Or------------------------ Orelia	IIIw	325	45	30	4.0
PaB----------------------- Papalote	IIIe	200	40	25	5.0

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Cotton lint	Grain sorghum	Corn	Pasture
		Lbs	Bu	Bu	AUM*
PtA----------------------- Papalote	IIs	250	45	25	5.5
PtB----------------------- Papalote	IIe	200	40	25	5.0
PtC----------------------- Papalote	IIIe	150	30	---	4.5
SfC----------------------- Sarita-Falfurrias	VIIe	---	---	---	---
Sn------------------------ Sinton	IIw	350	70	40	6.0
St------------------------ Sinton	Vw	---	---	---	6.0
Va------------------------ Victine	VIs	200	30	20	3.0
VcA----------------------- Victoria	IIs	450	60	40	4.0
VcB----------------------- Victoria	IIIe	350	55	35	4.0
Vd------------------------ Victoria	IIw	450	60	40	3.5
Vr------------------------ Vidauri	IIIw	350	50	35	6.0
Wy------------------------ Wyick	IIIw	350	50	35	6.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site	Potential annual production for kind of growing season: Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
Ac, Af: Aransas	Clayey Bottomland	8,000	6,500	4,500
As: Aransas	Salty Bottomland	7,000	5,000	2,000
Co: Copano	Sandy Loam	6,000	5,000	4,000
Dt: Dietrich	Sandy Coastal Flat	5,500	4,500	3,500
Ec: Edroy	Claypan Prairie	5,000	4,000	2,500
Ed: Edroy	Lakebed	5,000	4,000	3,000
Fd: Faddin	Loamy Prairie	7,000	6,000	4,000
FfC: Falfurrias	Sandy Hill	4,000	3,500	1,500
GmB:				
Galveston	Coastal Sand	4,500	3,000	2,000
Mustang	Low Coastal Sand	4,000	3,000	2,000
In: Inez	Sandy Loam	6,500	5,000	4,000
MoC, MoD4: Monteola	Rolling Blackland	4,000	3,500	2,500
Na: Narta	Salty Prairie	7,000	5,000	2,000
Od: Odem	Loamy Bottomland	7,000	6,000	4,000
Or: Orelia	Claypan Prairie	5,000	4,000	2,500
PaB: Papalote	Loamy Sand	4,500	3,900	2,000
PtA, PtB, PtC: Papalote	Tight Sandy Loam	4,800	4,000	2,000
SfC:				
Sarita	Sandy	5,000	4,000	2,000
Falfurrias	Sandy Hill	4,500	3,500	1,500

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
Sn, St------------------- Sinton	Loamy Bottomland------------------------	7,000	6,000	4,000
Va----------------------- Victine	Salty Prairie--------------------------	7,000	4,000	2,000
VcA, VcB, Vd------------- Victoria	Blackland------------------------------	5,000	4,000	2,500
Vr----------------------- Vidauri	Claypan Prairie------------------------	6,000	5,000	3,000
Wy----------------------- Wyick	Loamy Prairie--------------------------	6,000	5,000	3,000

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ac: Aransas	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
Af: Aransas	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, flooding.	Severe: ponding, too clayey.	Severe: ponding, flooding, too clayey.
As: Aransas	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, excess salt.	Severe: too clayey, ponding, flooding.	Severe: ponding, too clayey.	Severe: excess salt, ponding, droughty.
Ba: Barrada	Severe: flooding, ponding, excess salt.	Severe: ponding, excess sodium, excess salt.	Severe: ponding, excess sodium, excess salt.	Severe: ponding, too clayey.	Severe: excess salt, ponding, too clayey.
Co: Copano	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.
Dt: Dietrich	Severe: wetness, excess sodium.	Severe: wetness, excess sodium.	Severe: wetness, excess sodium.	Severe: wetness.	Severe: excess sodium, wetness.
Ec, Ed: Edroy	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
Fd: Faddin	Severe: percs slowly, wetness.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
FfC: Falfurrias	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
GmB:					
Galveston	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
Mustang	Severe: flooding, wetness, too sandy.	Severe: wetness, too sandy.	Severe: too sandy, wetness.	Severe: wetness, too sandy.	Severe: wetness.
In: Inez	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
MoC: Monteola	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
MoD4: Monteola	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.	Severe: too clayey.
Na: Narta	Severe: wetness, percs slowly, excess sodium.	Severe: wetness, excess sodium, excess salt.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness.	Severe: excess salt, excess sodium, wetness.
Od: Odem	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
Or: Orelia	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
PaB, PtA: Papalote	Slight	Slight	Slight	Slight	Slight.
PtB, PtC: Papalote	Slight	Slight	Moderate: slope.	Slight	Slight.
SfC:					
Sarita	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty.
Falfurrias	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
Sn: Sinton	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
St: Sinton	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Va: Victine	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: droughty, too clayey.
VcA: Victoria	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
VcB: Victoria	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
Vd: Victoria	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, too clayey.
Vr: Vidauri	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Wy--------------------- Wyick	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.

TABLE 8.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Ac: Aransas	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
Af: Aransas	Very poor	Poor	Fair	Fair	Poor	Good	Poor	Fair	Fair.
As: Aransas	Very poor	Poor	Poor	Fair	Poor	Good	Poor	Fair	Poor.
Ba: Barrada	Very poor	Very poor	Very poor	Very poor	Poor	Good	Very poor	Fair	Very poor.
Co: Copano	Poor	Fair	Fair	Fair	Good	Good	Poor	Good	Fair.
Dt: Dietrich	Fair	Fair	Fair	Good	Poor	Fair	Fair	Fair	Fair.
Ec: Edroy	Fair	Fair	Poor	Poor	Poor	Good	Fair	Fair	Poor.
Ed: Edroy	Very poor	Poor	Poor	Poor	Poor	Good	Poor	Fair	Poor.
Fd: Faddin	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
FfC: Falfurrias	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
GmB:									
Galveston	Poor	Fair	Fair	Fair	Very poor	Fair	Fair	Poor	Fair.
Mustang	Poor	Poor	Fair	Fair	Fair	Good	Poor	Fair	Fair.
In: Inez	Fair	Good	Good	Good	Fair	Fair	Fair	Fair	Good.
MoC: Monteola	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
MoD4: Monteola	Poor	Fair	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
Na: Narta	Poor	Poor	Very poor	Very poor	Fair	Fair	Poor	Fair	Very poor.
Od: Odem	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Or: Orelia	Fair	Fair	Good	Good	Fair	Fair	Fair	Fair	Good.
PaB, PtA, PtB, PtC: Papalote	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
SfC:									
Sarita------------	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Falfurrias--------	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
Sn----------------- Sinton	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
St----------------- Sinton	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
Va----------------- Victine	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor.
VcA, VcB, Vd------- Victoria	Good	Good	Poor	Fair	Poor	Fair	Good	Poor	Poor.
Vr----------------- Vidauri	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Wy----------------- Wyick	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ac---------------- Aransas	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, too clayey.
Af---------------- Aransas	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: ponding, flooding, too clayey.
As---------------- Aransas	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, flooding.	Severe: excess salt, ponding, droughty.
Ba---------------- Barrada	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: excess salt, ponding, too clayey.
Co---------------- Copano	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding.
Dt---------------- Dietrich	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: excess sodium, wetness.
Ec, Ed------------ Edroy	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding, too clayey.
Fd---------------- Faddin	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
FfC--------------- Falfurrias	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight-----------	Severe: droughty.
GmB:					
Galveston--------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Mustang----------	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: wetness, flooding.
In---------------- Inez	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MoC, MoD4 Monteola	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Na Narta	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: excess salt, excess sodium, wetness.
Od Odem	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Or Orelia	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: wetness.
PaB, PtA, PtB Papalote	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
PtC Papalote	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
SfC:					
Sarita	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: droughty.
Falfurrias	Severe: cutbanks cave.	Slight	Slight	Slight	Severe: droughty.
Sn Sinton	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
St Sinton	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Va Victine	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: droughty, too clayey.
VcA, VcB Victoria	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
Vd Victoria	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding, too clayey.
Vr Vidauri	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding.
Wy Wyick	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ac, Af, As: Aransas	Severe: flooding, ponding, percs slowly.	Severe: flooding, ponding.	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
Ba: Barrada	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess salt.	Severe: ponding.	Poor: too clayey, ponding, excess salt.
Co: Copano	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Dt: Dietrich	Severe: wetness, percs slowly.	Severe: wetness.	Severe: excess sodium, wetness.	Severe: wetness.	Poor: hard to pack, wetness, excess sodium.
Ec, Ed: Edroy	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Fd: Faddin	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: wetness, too clayey, hard to pack.
FfC: Falfurrias	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
GmB:					
Galveston	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Mustang	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
In: Inez	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
MoC, MoD4: Monteola	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Na----------------- Narta	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Od----------------- Odem	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Or----------------- Orelia	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness.	Severe: wetness.	Poor: wetness.
PaB, PtA----------- Papalote	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
PtB, PtC----------- Papalote	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
SfC: Sarita-------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Falfurrias---------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Sn, St------------- Sinton	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Va----------------- Victine	Severe: percs slowly.	Slight-----------	Severe: too clayey, excess salt.	Slight-----------	Poor: too clayey, hard to pack, excess salt.
VcA---------------- Victoria	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
VcB---------------- Victoria	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Vd----------------- Victoria	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Vr----------------- Vidauri	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Wy----------------- Wyick	Severe: ponding, percs slowly.	Slight-----------	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Ac, Af: Aransas	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
As: Aransas	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Ba: Barrada	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
Co: Copano	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer, wetness.
Dt: Dietrich	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
Ec, Ed: Edroy	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Fd: Faddin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
FfC: Falfurrias	Good	Probable	Improbable: too sandy.	Poor: too sandy.
GmB:				
Galveston	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Mustang	Poor: wetness.	Probable	Improbable: too sandy.	Poor: too sandy, wetness.
In: Inez	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
MoC, MoD4: Monteola	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Na: Narta	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness, excess sodium.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
Od----------------- Odem	Good----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
Or----------------- Orelia	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
PaB, PtA, PtB, PtC---- Papalote	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
SfC:				
Sarita---------------	Good----------------	Improbable: excess fines.	Improbable: too sandy.	Poor: too sandy.
Falfurrias-----------	Good----------------	Probable------------	Improbable: too sandy.	Poor: too sandy.
Sn, St--------------- Sinton	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Va------------------ Victine	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
VcA, VcB------------- Victoria	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Vd------------------ Victoria	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Vr------------------ Vidauri	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer, wetness.
Wy------------------ Wyick	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer, wetness.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions
Ac, Af: Aransas	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, flooding.	Ponding, percs slowly.
As: Aransas	Slight	Severe: hard to pack, ponding, excess salt.	Ponding, percs slowly, flooding.	Ponding, percs slowly.
Ba: Barrada	Slight	Severe: ponding, excess sodium, excess salt.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.
Co: Copano	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, soil blowing, percs slowly.
Dt: Dietrich	Slight	Severe: wetness, excess sodium.	Percs slowly, excess sodium.	Wetness, soil blowing, percs slowly.
Ec, Ed: Edroy	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly.	Ponding, percs slowly.
Fd: Faddin	Slight	Severe: hard to pack.	Percs slowly	Erodes easily, wetness, percs slowly.
FfC: Falfurrias	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.
GmB:				
Galveston	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy.
Mustang	Severe: seepage.	Severe: seepage, piping, wetness.	Ponding, flooding, cutbanks cave.	Wetness, too sandy, soil blowing.
In: Inez	Slight	Severe: hard to pack, wetness.	Percs slowly	Erodes easily, wetness, percs slowly.
MoC, MoD4: Monteola	Moderate: slope.	Severe: hard to pack.	Deep to water	Erodes easily, percs slowly.
Na: Narta	Slight	Severe: wetness, excess sodium, excess salt.	Percs slowly, excess salt, excess sodium.	Erodes easily, wetness, percs slowly.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--	
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Terraces and diversions
Od: Odem	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing.
Or: Orelia	Slight	Severe: wetness.	Percs slowly, excess salt.	Wetness, percs slowly.
PaB, PtA, PtB, PtC: Papalote	Slight	Moderate: hard to pack.	Deep to water	Soil blowing, percs slowly.
SfC:				
Sarita	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.
Falfurrias	Severe: seepage.	Severe: seepage, piping.	Deep to water	Too sandy, soil blowing.
Sn, St: Sinton	Severe: seepage.	Severe: piping.	Deep to water	Favorable.
Va: Victine	Slight	Severe: hard to pack, excess salt.	Deep to water	Percs slowly.
VcA, VcB: Victoria	Slight	Severe: hard to pack.	Deep to water	Percs slowly.
Vd: Victoria	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.
Vr: Vidauri	Slight	Severe: ponding.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.
Wy: Wyick	Slight	Severe: ponding.	Ponding, percs slowly.	Ponding, soil blowing.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than. Absence of an entry indicates that data were not estimated. Some soils have Unified classifications and USDA textures that are supplementary to those shown. In general, the dominant classifications and textures are shown, and the others are inferred]

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Ac, Af, As------- Aransas	0-60	Clay, clay loam	CH	A-7-6	100	95-100	95-100	75-95	51-75	30-50
Ba--------------- Barrada	0-54	Clay, clay loam	CH	A-7-6	90-100	85-100	80-100	80-100	51-66	27-39
Co--------------- Copano	0-14	Fine sandy loam	SM-SC, SC	A-2-4, A-4	100	95-100	70-100	25-50	<25	NP-10
	14-42	Clay, sandy clay	CL, CH	A-7-6	96-100	95-100	90-100	55-75	41-66	25-45
	42-56	Sandy clay loam, clay loam, sandy clay.	CL, CH	A-6, A-7-6	96-100	95-100	90-100	55-75	36-55	22-35
	56-72	Sandy clay loam, clay loam, sandy clay.	CL, CH	A-6, A-7-6	96-100	95-100	90-100	55-75	36-55	22-35
Dt--------------- Dietrich	0-9	Loamy fine sand	SM, SM-SC	A-2-4	100	100	90-100	15-35	<25	NP-7
	9-44	Clay loam, sandy clay loam, loam.	SC, CL, CH	A-7-6, A-6	100	100	90-100	39-70	40-53	22-35
	44-60	Loam, sandy clay loam.	SC, CL, CH	A-7-6, A-6	95-100	90-100	85-100	36-66	40-55	25-40
Ec, Ed----------- Edroy	0-28	Clay-------------	CH	A-7-6	100	100	90-100	75-95	51-60	27-35
	28-42	Clay loam, clay, sandy clay.	CL, CH	A-7-6	100	95-100	90-100	70-90	41-55	20-30
	42-60	Sandy clay loam, clay loam.	SC, CL	A-7-6, A-6	100	95-100	80-95	40-55	30-42	11-20
Fd--------------- Faddin	0-19	Fine sandy loam	SM, SM-SC	A-4, A-2-4	98-100	98-100	90-100	33-49	<25	NP-7
	19-52	Sandy clay, clay	CL, CH	A-7-6	100	98-100	90-100	55-75	41-66	25-45
	52-60	Sandy clay loam, sandy clay.	CL, SC	A-7-6, A-6	95-100	90-100	85-100	45-70	40-49	25-33
FfC-------------- Falfurrias	0-99	Fine sand--------	SP-SM, SM	A-2-4, A-3	100	100	75-100	5-25	<25	NP-3
GmB:										
Galveston-------	0-4	Fine sand--------	SP-SM, SM, SP	A-3, A-2-4	100	95-100	65-90	2-20	<30	NP-3
	4-80	Fine sand, sand	SP-SM, SP	A-3, A-2-4	100	90-100	65-90	2-10	<30	NP-3
Mustang---------	0-6	Fine sand--------	SW-SM, SP-SM, SP	A-2-4, A-3	85-100	80-100	60-80	2-12	<25	NP-3
	6-80	Fine sand, sand	SW-SM, SP-SM, SP	A-2-4, A-3	85-100	80-100	60-80	2-12	<25	NP-3
In--------------- Inez	0-14	Fine sandy loam	SM, SM-SC	A-2-4, A-4	98-100	98-100	90-100	25-49	<25	NP-7
	14-48	Clay, sandy clay	CL, CH	A-7-6	98-100	98-100	90-100	55-75	41-66	25-45
	48-64	Sandy clay, clay loam, sandy clay loam.	CL, CH	A-6, A-7-6	98-100	98-100	90-100	55-75	36-55	25-40
MoC, MoD4-------- Monteola	0-24	Clay-------------	CH	A-7-6	80-100	80-100	80-100	75-90	51-75	30-50
	24-72	Clay-------------	CH	A-7-6	90-100	80-100	75-100	75-96	56-80	33-54

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Na---------------- Narta	0-7	Fine sandy loam	SC, CL, SM, ML	A-4, A-6	100	100	100	36-75	<30	NP-15
	7-54	Silty clay, clay, clay loam, silty clay loam.	CH, CL	A-7-6	98-100	95-100	90-100	60-80	48-66	35-45
	54-60	Clay loam, sandy clay, clay.	CH, CL	A-7-6	95-100	90-100	90-100	51-80	43-70	30-49
Od---------------- Odem	0-68	Fine sandy loam	SM-SC, SM	A-2-4	100	100	90-100	20-30	<25	NP-7
Or---------------- Orelia	0-6	Fine sandy loam	SC, CL, SM-SC, CL-ML	A-4, A-6, A-2	98-100	95-100	80-100	33-60	22-35	6-19
	6-20	Sandy clay loam, clay loam.	CL, SC	A-7, A-6	98-100	90-100	80-100	47-75	35-50	20-30
	20-60	Sandy clay loam, loam.	CL	A-6, A-7-6	95-100	85-100	80-100	51-75	35-47	20-32
PaB--------------- Papalote	0-11	Loamy fine sand	SM, SM-SC	A-2-4	95-100	90-100	50-100	15-35	<25	NP-6
	11-43	Sandy clay, clay, clay loam.	CL, SC, CH	A-7-6	95-100	90-100	85-100	40-70	41-61	21-36
	43-60	Sandy clay loam, sandy clay.	CL, SC	A-6, A-7-6	95-100	80-100	75-96	36-70	35-49	18-31
PtA, PtB, PtC----- Papalote	0-11	Fine sandy loam	SM, SM-SC, SC	A-2-4, A-4	95-100	95-100	90-100	22-50	<25	NP-8
	11-43	Sandy clay, clay, clay loam.	CL, SC, CH	A-7-6	95-100	90-100	85-100	43-70	41-61	21-36
	43-60	Sandy clay loam, sandy clay.	CL, SC	A-6, A-7-6	95-100	80-100	75-96	36-70	35-49	18-31
SfC: Sarita-----------	0-50	Fine sand, loamy fine sand.	SM-SC, SP-SM, SM	A-2-4, A-3	100	100	65-100	9-35	<25	NP-7
	50-72	Sandy clay loam, fine sandy loam.	SC	A-2-6, A-6	100	100	80-100	30-50	28-40	11-22
Falfurrias-------	0-99	Fine sand---------	SP-SM, SM	A-2-4, A-3	100	100	75-100	5-25	<25	NP-3
Sn, St----------- Sinton	0-35	Clay loam, loam, sandy clay loam.	CL	A-4, A-6	100	95-100	85-100	50-80	27-40	9-20
	35-70	Stratified loamy fine sand to sandy clay loam.	SM, SC, ML, CL	A-2-4, A-2-6, A-4, A-6	100	90-100	50-100	20-52	<30	NP-14
Va---------------- Victine	0-14	Clay--------------	CH	A-7-6	100	95-100	90-100	65-95	55-75	35-49
	14-44	Clay, silty clay	CH	A-7-6	95-100	95-100	85-100	65-95	58-75	35-49
	44-72	Clay, silty clay	CH	A-7-6	95-100	90-100	85-100	65-90	54-75	35-49
VcA, VcB, Vd------ Victoria	0-9	Clay--------------	CH	A-7-6	100	95-100	90-100	70-90	58-75	35-49
	9-72	Clay, silty clay	CH	A-7-6	100	95-100	90-100	70-90	58-75	35-49
	72-94	Clay, silty clay	CH	A-7-6	100	95-100	90-100	70-90	58-75	35-49

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	4	10	40	200		
	In								Pct	
Vr----------------- Vidauri	0-6	Fine sandy loam	SM-SC, CL-ML, SC, CL	A-4, A-6	100	100	90-100	45-75	23-40	6-20
	6-21	Clay, sandy clay, clay loam.	CH	A-7-6	100	98-100	90-100	60-90	50-72	28-46
	21-31	Clay, sandy clay, clay loam.	CL, CH	A-7-6	100	98-100	80-100	60-85	41-60	20-36
	31-66	Sandy clay, sandy clay loam.	CL, CH	A-7-6, A-6	98-100	95-100	80-100	55-80	30-60	15-35
Wy----------------- Wyick	0-10	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-4	100	100	70-90	40-65	<25	NP-7
	10-21	Clay, sandy clay	CH	A-7-6	100	95-100	90-100	70-95	51-72	30-46
	21-38	Sandy clay loam, clay loam, sandy clay, clay.	CH, SC, CL	A-6, A-7-6	95-100	95-100	85-100	45-75	38-62	21-39
	38-60	Sandy clay loam, sandy clay, clay.	CH, SC, CL	A-6, A-7-6	95-100	95-100	80-100	36-65	37-60	20-38

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Organic matter
									K	T	
	In	Pct	G/cc	In/hr	In/in	pH	mmho/cm				Pct
Ac, Af----------- Aransas	0-60	35-60	1.35-1.60	<0.06	0.12-0.18	7.9-8.4	<4	High--------	0.32	5	1-4
As--------------- Aransas	0-60	35-60	1.35-1.60	<0.06	0.01-0.12	7.9-9.0	>4	High--------	0.32	5	1-4
Ba--------------- Barrada	0-54	45-60	1.20-1.50	<0.06	0.-0.01	7.9-9.0	>16	High--------	0.32	5	<1
Co--------------- Copano	0-14	7-18	1.40-1.65	2.0-6.0	0.10-0.15	5.6-7.3	<2	Low---------	0.28	5	.5-2
	14-42	38-55	1.40-1.60	<0.06	0.13-0.17	6.6-8.4	<2	High--------	0.32		
	42-56	30-55	1.50-1.70	0.2-0.6	0.12-0.16	7.4-8.4	<2	Moderate----	0.32		
	56-72	30-55	1.30-1.50	0.2-0.6	0.12-0.16	7.9-8.4	<2	Moderate----	0.32		
Dt--------------- Dietrich	0-9	2-12	1.45-1.70	2.0-6.0	0.05-0.10	6.1-7.3	<2	Low---------	0.20	5	<1
	9-44	25-35	1.55-1.70	0.06-0.2	0.08-0.15	7.4-8.4	<8	Moderate----	0.32		
	44-60	20-35	1.50-1.70	0.2-0.6	0.05-0.15	7.9-8.4	2-8	Moderate----	0.32		
Ec, Ed----------- Edroy	0-28	40-55	1.35-1.55	<0.06	0.10-0.17	6.1-7.3	<8	High--------	0.32	5	1-4
	28-42	35-50	1.35-1.55	0.06-0.2	0.09-0.17	7.3-8.4	<8	High--------	0.32		
	42-60	20-35	1.35-1.65	0.06-0.2	0.08-0.16	7.9-8.4	<8	Moderate----	0.37		
Fd--------------- Faddin	0-19	6-15	1.55-1.70	0.6-2.0	0.12-0.17	6.1-7.3	<2	Low---------	0.43	5	1-3
	19-52	35-50	1.35-1.60	<0.06	0.14-0.19	6.1-8.4	<2	High--------	0.32		
	52-60	30-45	1.45-1.70	0.06-0.2	0.14-0.18	7.4-8.4	<2	Moderate----	0.32		
FfC-------------- Falfurrias	0-99	1-9	1.45-1.65	6.0-20	0.02-0.08	6.1-8.4	<2	Very low----	0.15	5	<1
GmB:											
Galveston--------	0-4	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15	5	<1
	4-80	2-8	1.50-1.70	6.0-20	0.05-0.10	5.6-8.4	<4	Low---------	0.15		
Mustang----------	0-6	2-8	1.50-1.70	6.0-20	0.01-0.07	6.6-8.4	<4	Low---------	0.15	5	<1
	6-80	2-8	1.50-1.70	6.0-20	0.01-0.06	6.6-8.4	<8	Low---------	0.15		
In--------------- Inez	0-14	6-18	1.40-1.65	0.6-2.0	0.09-0.13	5.6-7.3	<2	Low---------	0.43	5	<2
	14-48	35-55	1.40-1.60	<0.06	0.14-0.19	4.5-7.3	<2	High--------	0.32		
	48-64	25-40	1.30-1.50	0.06-0.2	0.14-0.19	6.6-8.4	<2	Moderate----	0.32		
MoC, MoD4-------- Monteola	0-24	40-55	1.40-1.55	<0.06	0.10-0.20	7.9-9.0	<4	Very high	0.32	5	1-3
	24-72	40-60	1.40-1.70	<0.06	0.10-0.17	7.9-9.0	<4	Very high	0.37		
Na--------------- Narta	0-7	10-25	1.40-1.60	0.6-2.0	0.05-0.11	6.6-8.4	2-16	Low---------	0.49	5	.5-2
	7-54	35-45	1.45-1.65	<0.06	0.-0.02	7.4-9.0	>8	High--------	0.43		
	54-60	30-45	1.40-1.60	<0.06	0.-0.02	7.9-9.0	>8	High--------	0.43		
Od--------------- Odem	0-68	7-18	1.50-1.65	2.0-6.0	0.10-0.16	6.1-8.4	<2	Low---------	0.24	5	1-3
Or--------------- Orelia	0-6	17-25	1.40-1.60	0.2-0.6	0.10-0.16	6.6-7.8	<4	Low---------	0.28	5	<1
	6-20	28-35	1.35-1.55	0.06-0.2	0.10-0.17	6.6-8.4	<8	Moderate----	0.32		
	20-60	20-35	1.35-1.55	<0.06	0.09-0.17	7.4-9.0	<16	Moderate----	0.32		

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmho/cm				Pct
PaB--------------- Papalote	0-11 11-43 43-60	4-15 35-55 30-40	1.50-1.70 1.35-1.60 1.45-1.70	2.0-6.0 0.06-0.2 0.06-0.2	0.07-0.11 0.13-0.18 0.12-0.17	5.6-7.8 6.1-8.4 6.6-8.4	<2 <2 <2	Low--------- Moderate---- Moderate----	0.32 0.32 0.32	5	<1
PtA, PtB, PtC---- Papalote	0-11 11-43 43-60	6-17 35-55 30-40	1.45-1.70 1.35-1.60 1.45-1.70	2.0-6.0 0.06-0.2 0.06-0.2	0.11-0.15 0.13-0.18 0.12-0.17	5.6-7.8 6.1-8.4 6.6-8.4	<2 <2 <2	Low--------- Moderate---- Moderate----	0.32 0.32 0.32	5	<1
SfC:											
Sarita-----------	0-50 50-72	1-13 18-34	1.50-1.75 1.35-1.65	6.0-20 2.0-6.0	0.05-0.10 0.13-0.19	6.1-7.3 6.1-8.4	<2 <2	Low--------- Moderate----	0.17 0.24	5	<1
Falfurrias-------	0-99	1-9	1.45-1.65	6.0-20	0.02-0.08	6.1-8.4	<2	Very low----	0.15	5	<1
Sn, St----------- Sinton	0-35 35-70	18-35 10-35	1.35-1.60 1.40-1.65	0.6-2.0 2.0-6.0	0.15-0.20 0.07-0.15	7.9-8.4 7.9-8.4	<2 <2	Low--------- Low---------	0.28 0.20	5	1-3
Va---------------- Victine	0-14 14-44 44-72	45-60 45-60 45-60	1.35-1.55 1.35-1.60 1.40-1.70	<0.06 <0.06 <0.06	0.09-0.15 0.02-0.11 0.01-0.10	7.9-9.0 7.9-9.0 7.9-9.0	<4 4-16 >8	Very high Very high Very high	0.32 0.32 0.32	5	1-3
VcA, VcB, Vd----- Victoria	0-9 9-72 72-94	40-55 45-60 40-60	1.35-1.55 1.35-1.60 1.40-1.70	<0.06 <0.06 <0.06	0.18-0.21 0.13-0.20 0.02-0.15	7.9-8.4 7.9-9.0 7.9-9.0	<4 <8 4-16	Very high Very high Very high	0.32 0.32 0.32	5	1-3
Vr---------------- Vidauri	0-6 6-21 21-31 31-66	12-25 35-55 35-55 30-55	1.40-1.70 1.35-1.70 1.40-1.70 1.45-1.75	0.6-2.0 <0.06 <0.06 0.2-0.6	0.10-0.15 0.15-0.20 0.15-0.20 0.15-0.20	5.1-6.5 5.6-7.3 6.1-8.4 7.4-8.4	<2 <2 <2 <2	Low--------- High-------- High-------- High--------	0.37 0.32 0.32 0.32	5	.5-2
Wy---------------- Wyick	0-10 10-21 21-38 38-60	6-18 35-55 33-45 30-42	1.40-1.70 1.35-1.65 1.40-1.60 1.30-1.50	0.6-2.0 <0.06 0.06-0.2 0.2-0.6	0.10-0.15 0.15-0.20 0.13-0.18 0.12-0.16	6.1-7.3 6.1-7.3 6.1-8.4 7.9-8.4	<2 <2 <2 <4	Low--------- High-------- High-------- Moderate----	0.32 0.32 0.32 0.28	5	<1

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydrologic group	Flooding			High water table			Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Uncoated steel	Concrete
					Ft				
Ac: Aransas	D	Occasional	Very brief to brief.	Sep-May	+3-5.0	Apparent	Sep-Jun	High	Low.
Af, As: Aransas	D	Frequent	Brief to very long.	Sep-May	+3-5.0	Apparent	Sep-Jun	High	Low.
Ba: Barrada	D	Frequent	Brief to long.	Jan-Dec	+1-3.0	Apparent	Jan-Dec	High	Moderate.
Co: Copano	D	None	---	---	+.5-1.5	Perched	Sep-Apr	High	Low.
Dt: Dietrich	C	None	---	---	0.5-3.0	Perched	Sep-May	High	Moderate.
Ec, Ed: Edroy	D	None	---	---	+2-4.0	Apparent	Sep-May	High	Low.
Fd: Faddin	D	None	---	---	1.0-1.5	Perched	Nov-Mar	High	Low.
FfC: Falfurrias	A	None	---	---	>6.0	---	---	Low	Low.
GmB:									
Galveston	A	Occasional	Very brief	Jun-Oct	3.0-6.0	Apparent	Jan-Dec	High	Low.
Mustang	A/D	Occasional	Brief to long.	Aug-Nov	+1-0.5	Apparent	Jan-Dec	High	Low.
In: Inez	D	None	---	---	0-1.5	Perched	Nov-Mar	High	Low.
MoC, MoD4: Monteola	D	None	---	---	>6.0	---	---	High	Low.
Na: Narta	D	None	---	---	0-0.5	Perched	Sep-May	High	Moderate.
Od: Odem	A	Occasional	Very brief to brief.	Sep-May	>6.0	---	---	Moderate	Low.
Or: Orelia	D	None	---	---	0.5-1.0	Perched	Sep-May	High	Low.
PaB, PtA, PtB, PtC: Papalote	C	None	---	---	>6.0	---	---	High	Low.
SfC:									
Sarita	A	None	---	---	>6.0	---	---	Low	Low.
Falfurrias	A	None	---	---	>6.0	---	---	Low	Low.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Uncoated steel	Concrete
					Ft				
Sn----------------- Sinton	B	Occasional	Very brief to brief.	Sep-May	>6.0	---	---	Moderate	Low.
St----------------- Sinton	B	Frequent----	Brief to long.	Sep-May	>6.0	---	---	Moderate	Low.
Va----------------- Victine	D	None--------	---	---	>6.0	---	---	High-----	Low.
VcA, VcB---------- Victoria	D	None--------	---	---	>6.0	---	---	High-----	Low.
Vd----------------- Victoria	D	None--------	---	---	+.5-6.0	Perched	Sep-May	High-----	Low.
Vr----------------- Vidauri	D	None--------	---	---	+.2-1.5	Perched	Sep-Apr	High-----	Low.
Wy----------------- Wyick	D	None--------	---	---	+.5-1.0	Perched	Sep-Apr	High-----	Low.

TABLE 16.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available]

Soil name, sample number, horizon and depth in inches	Classification		Grain-size distribution								Liquid limit 1/	Plasticity index 1/	Specific gravity	Shrinkage		
			Percentage passing sieve--					Percentage smaller than--								
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
											Pct		G/cc	Pct	Pct	Pct
Dietrich loamy fine sand: 2/																
THD79TX-391-1																
A - - - - - 0-7	A-2-4(0)	SM-SC	100	100	100	100	33	25	9	6	22	6	2.61	17	3.0	1.74
E - - - - - 7-9 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Btng1 - - 9-18	A-7-6(9)	SC	100	100	100	100	47	40	33	30	46	29	2.64	16	13.8	1.83
Btng2 - - 18-30 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BCncg - - 30-44	A-6(3)	SC	100	100	100	100	39	31	28	26	40	22	2.67	18	10.2	1.76
Faddin fine sandy loam: 4/																
THD79TX-391-5																
A - - - - - 0-10	A-2-4(0)	SM-SC	100	100	100	97	33	21	7	4	19	4	2.61	19	0.0	1.71
Btg - - - 10-17	A-7-6(25)	CH	100	100	100	98	60	53	40	39	53	32	2.61	13	16.8	1.94
Btcg - - 17-29 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BCkc - - 29-43	A-7-6(8)	SC	100	100	100	98	48	39	24	23	41	26	2.64	15	12.2	1.88
Ckc - - - 43-60	A-6(9)	CL	100	100	100	98	52	41	30	25	40	26	2.67	12	13.7	1.95
Narta fine sandy loam: 5/																
A - - - - - 0-7	A-4(2)	CL-ML	100	100	100	100	51	37	26	12	24	7	2.61	17	4.0	1.76
Btnzg - - 7-15	A-7-6(25)	CH	100	100	99	97	63	62	46	40	66	42	2.63	14	20.3	1.90
Btknzg - - 15-28 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BCknzg - - 28-38	A-7-6(38)	CH	100	100	100	96	75	63	50	44	70	49	2.62	13	22.4	1.98
Ck - - - - 38-65	A-7-6(26)	CH	100	100	100	98	69	61	45	38	55	38	2.63	14	18.4	1.97
Orelia fine sandy loam: 2/																
THD79TX-391-3																
A - - - - - 0-6	A-6(2)	SC	100	100	100	99	44	34	16	13	27	11	2.62	16	5.8	1.79
Btg1 - - 6-13	A-6(8)	CL	100	100	100	100	51	46	29	27	36	22	2.61	14	11.0	1.89
Btg2 - - 13-20 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bkg - - - 20-37	A-7-6(14)	CL	100	100	100	98	55	48	33	31	47	32	2.66	11	16.6	1.99
Ck - - - 37-60	A-7-6(14)	CL	100	100	99	92	58	53	36	27	42	30	2.63	10	15.6	2.04

See footnotes at end of table.

TABLE 16.--ENGINEERING INDEX TEST DATA--Continued

Soil name, sample number, horizon and depth in inches	Classification		Grain-size distribution: Percentage passing sieve--					Percentage smaller than--			Liquid limit 1/	Plasticity index 1/	Particle density	Shrinkage		
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
											Pct		G/cc	Pct	Pct	Pct
Papalote loamy fine sand: 6/																
THD79TX-391-4																
A - - - - 0-10	A-2-4(0)	SM	100	100	100	84	22	5	4	3	15	1	2.64	16	0.0	1.85
E - - - - 10-15 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Btg1 - - 15-22	A-7-6(14)	CH	100	100	100	89	52	36	32	30	61	32	2.62	20	16.2	1.72
Btg2 - - 22-30 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BCkzg - - 30-40	A-7-6(5)	SC	100	100	100	89	40	24	15	14	42	26	2.61	13	13.6	1.92
Ckz - - - 40-60	A-7-6(3)	SC	100	100	99	88	38	20	10	9	38	23	2.64	15	11.1	1.85
Victine clay: 2/																
THD79TX-391-6																
Az1 - - - 0-14	A-7-6(29)	CH	100	100	100	99	76	68	46	40	55	37	2.65	10	19.1	1.97
Az2 - - - 14-44 3/	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bkyz - - - 44-64	A-7-6(29)	CH	100	100	100	100	71	60	47	45	59	41	2.62	10	21.3	2.07
Ckyz - - - 64-72	A-7-6(23)	CH	100	99	96	94	67	54	38	34	54	37	2.61	11	19.0	2.04

1/ Liquid limit and plasticity index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water. Group index by AASHTO M-145-49.

2/ See the section "Soil Series and Their Morphology" for location of the pedon.

3/ Combined with horizon above for sampling purposes, no materials were discarded.

4/ Faddin fine sandy loam: From Refugio, 11.3 miles north on U.S. Highway 77, 6.4 miles northwest on a private road, 1.1 mile north on a private road, and 200 feet west, in pastureland.

5/ Narta fine sandy loam: From Refugio, 15 miles east on Farm Road 774 and 100 feet north along pipeline right-of-way, in rangeland.

6/ Papalote loamy fine sand: From Refugio, 2 miles northwest on U.S. Highway 183, 4 miles west on Texas Highway 202, 0.8 mile south on Kelly Road, and 200 feet east, in rangeland.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Aransas	Fine, montmorillonitic [calcareous], hyperthermic Vertic Haplaquolls
Barrada	Fine, mixed, hyperthermic Aquollic Salorthids
Copano	Fine, montmorillonitic, hyperthermic Vertic Albaqualfs
Dietrich	Fine-loamy, mixed, hyperthermic Typic Natraqualfs
Edroy	Fine, mixed, hyperthermic Vertic Haplaquolls
Faddin	Fine, montmorillonitic, hyperthermic Abruptic Argiaquolls
Falfurrias	Mixed, hyperthermic Typic Ustipsamments
Galveston	Mixed, hyperthermic Typic Udipsamments
Inez	Fine, montmorillonitic, hyperthermic Typic Albaqualfs
Monteola	Fine, montmorillonitic, hyperthermic Typic Pellusterts
Mustang	Mixed, hyperthermic Typic Psammaquents
Narta	Fine, montmorillonitic, hyperthermic Typic Natraqualfs
Odem	Coarse-loamy, mixed, hyperthermic Cumulic Haplustolls
Orelia	Fine-loamy, mixed, hyperthermic Typic Ochraqualfs
Papalote	Fine, mixed, hyperthermic Aquic Paleustalfs
Sarita	Loamy, mixed, hyperthermic Grossarenic Paleustalfs
Sinton	Fine-loamy, mixed, hyperthermic Cumulic Haplustolls
Victine	Fine, montmorillonitic, hyperthermic Udic Pellusterts
Victoria	Fine, montmorillonitic, hyperthermic Udic Pellusterts
Vidauri	Fine, montmorillonitic, hyperthermic Vertic Albaqualfs
Wyick	Fine, montmorillonitic, hyperthermic Typic Albaqualfs

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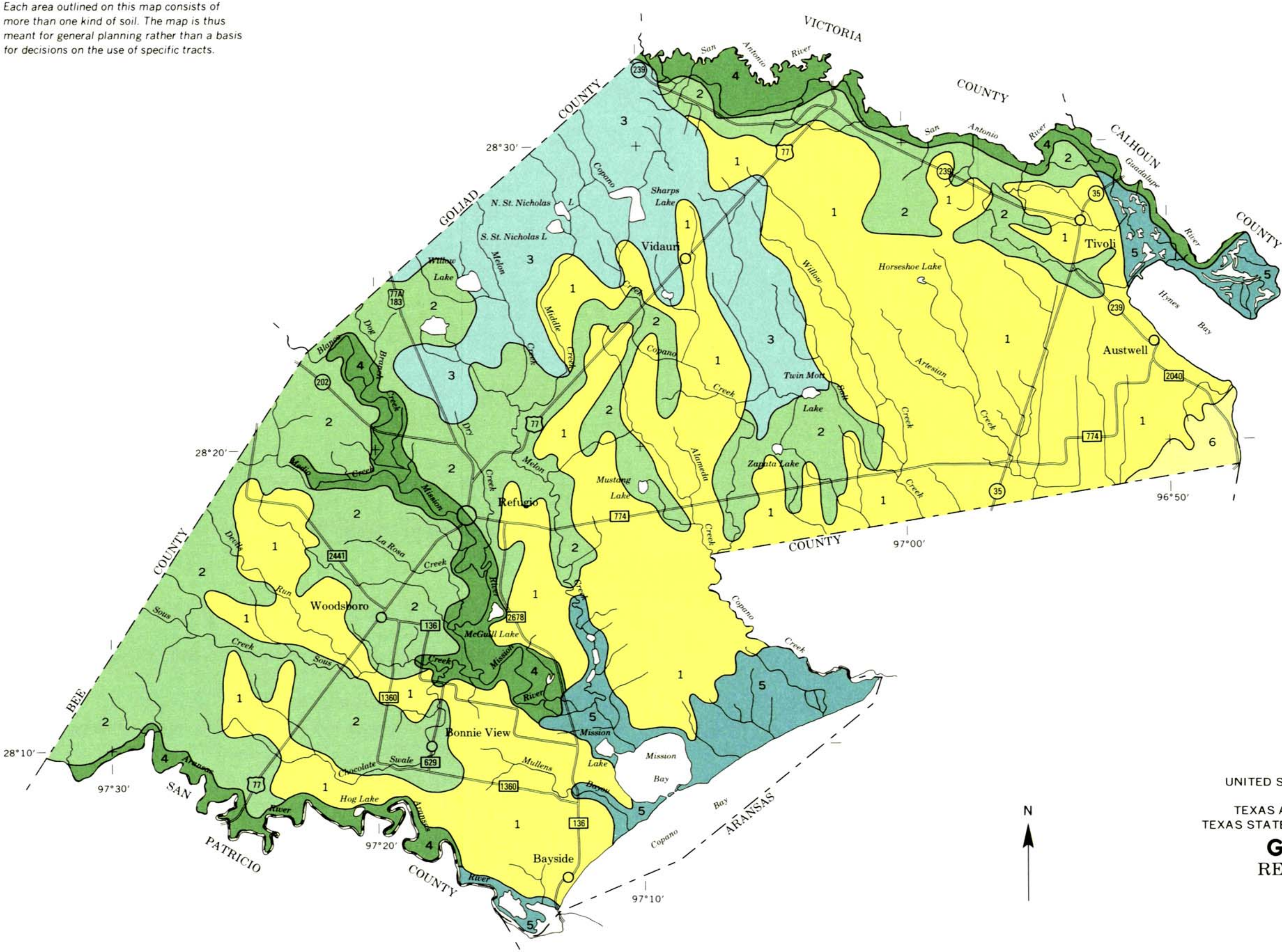
Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



LEGEND*

1	VICTORIA-EDROY-ORELIA: Deep, moderately alkaline to slightly acid, clayey and loamy soils formed in clayey and loamy marine sediments; on uplands
2	PAPALOTE-ORELIA: Deep, neutral or slightly acid, loamy and sandy soils formed in clayey and loamy sediments; on uplands
3	FADDIN-WYICK-VIDAURI: Deep and moderately deep, slightly acid, loamy soils formed in clayey and loamy sediments; on uplands
4	ARANSAS-SINTON-ODEM: Deep, moderately alkaline or mildly alkaline, clayey and loamy soils formed in recent alluvium; on flood plains and low stream terraces
5	ARANSAS-VICTINE-NARTA: Deep, saline, moderately alkaline, clayey and loamy soils formed in recent alluvium and marine sediment; on coastal flood plains and low terraces
6	DIETRICH-GALVESTON-MUSTANG: Deep, neutral or mildly alkaline, sandy soils formed in loamy and sandy marine sediments; on low coastal plains

*The soil reaction and the texture are for the surface layer of the typical pedon of the major soils.

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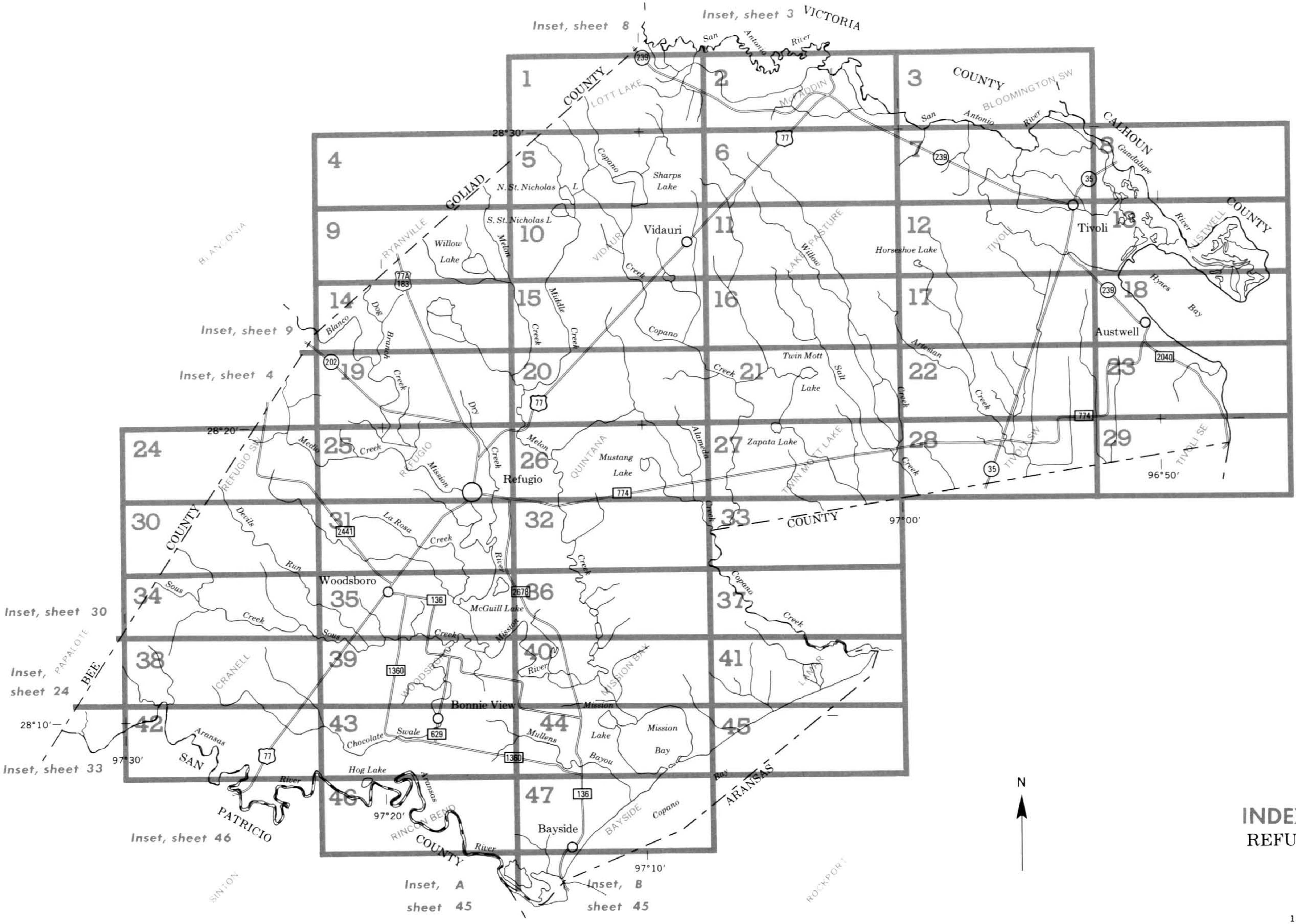
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION
TEXAS STATE SOIL AND WATER CONSERVATION BOARD

GENERAL SOIL MAP
REFUGIO COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



INDEX TO MAP SHEETS
REFUGIO COUNTY, TEXAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

Soil map publication symbols and map unit names are listed alphabetically. The first letter is always a capital and is the initial letter of the soil name. The second letter is lower case. The third letter, if used, is a capital letter and indicates slope class. Symbols without a slope letter are nearly level soils. The fourth symbol is a number, if used, and indicates the erosion class.

SYMBOL	NAME
Ac	Aransas clay, occasionally flooded
Af	Aransas clay, frequently flooded
As	Aransas clay, saline, frequently flooded
Ba	Barrada clay
Co	Copano fine sandy loam
Dt	Dietrich loamy fine sand
Ec	Edroy clay
Ed	Edroy clay, depressional
Fd	Faddin fine sandy loam
FfC	Falfurrias fine sand, 0 to 5 percent slopes
GmB	Galveston-Mustang fine sands, 0 to 3 percent slopes
In	Inez fine sandy loam
MoC	Monteola clay, 3 to 5 percent slopes
MoD4	Monteola clay, 5 to 8 percent slopes, gullied
Na	Narta fine sandy loam
Od	Odem fine sandy loam, occasionally flooded
Or	Orelia fine sandy loam
PaB	Papalote loamy fine sand, 0 to 3 percent slopes
PtA	Papalote fine sandy loam, 0 to 1 percent slopes
PtB	Papalote fine sandy loam, 1 to 3 percent slopes
PtC	Papalote fine sandy loam, 3 to 5 percent slopes
SfC	Sarita-Falfurrias fine sands, 0 to 5 percent slopes
Sn	Sinton clay loam, occasionally flooded
St	Sinton clay loam, frequently flooded
Va	Victine clay
VcA	Victoria clay, 0 to 1 percent slopes
VcB	Victoria clay, 1 to 3 percent slopes
Vd	Victoria clay, depressional
Vr	Vidauri fine sandy loam
Wy	Wyick fine sandy loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label) — Swift Airport; FLOOD POOL LINE

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate — 21
- Federal — 173
- State — 28
- County, farm or ranch — 1283

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — Gas
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — Ac Vr

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown) — S

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Oil waste-land

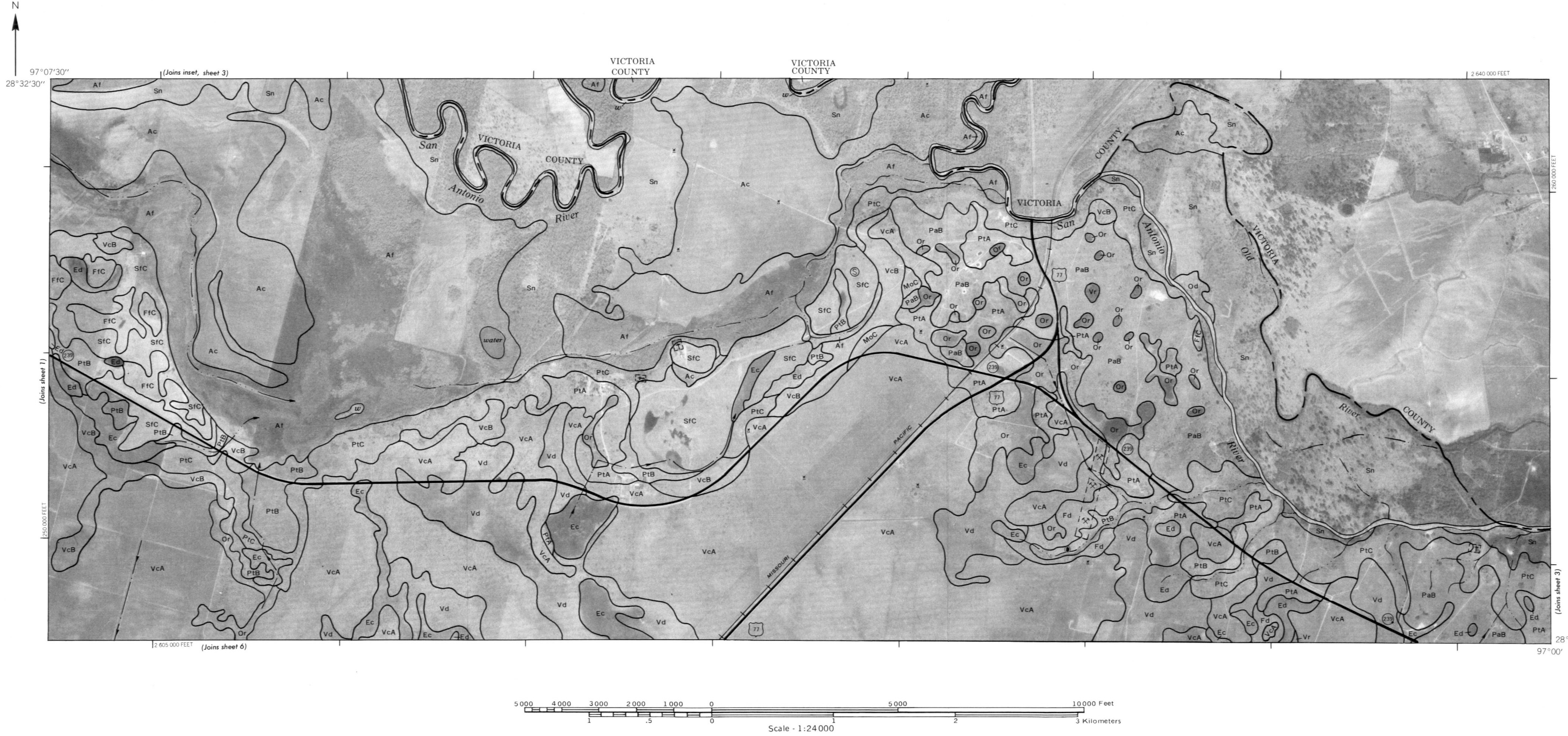
REFUGIO COUNTY, TEXAS — SHEET NUMBER 1

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

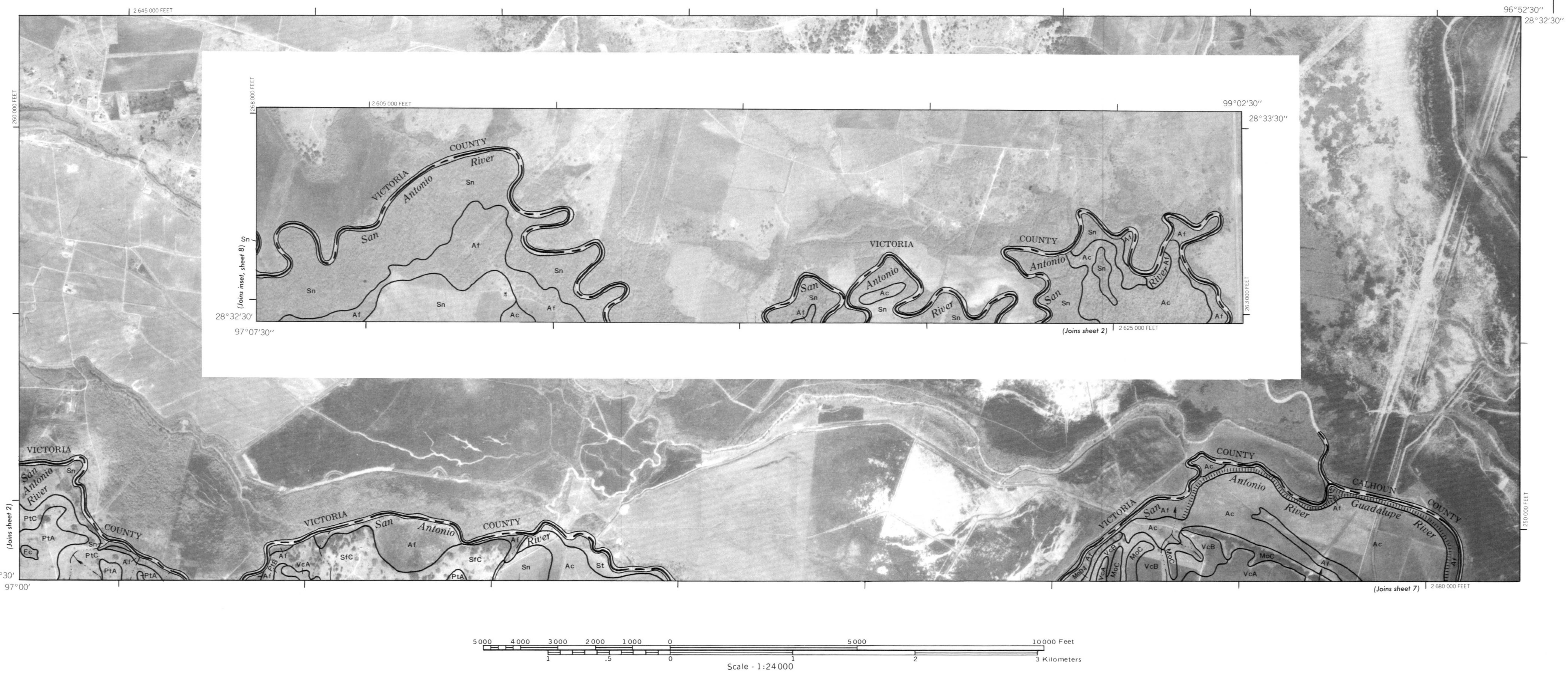
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000



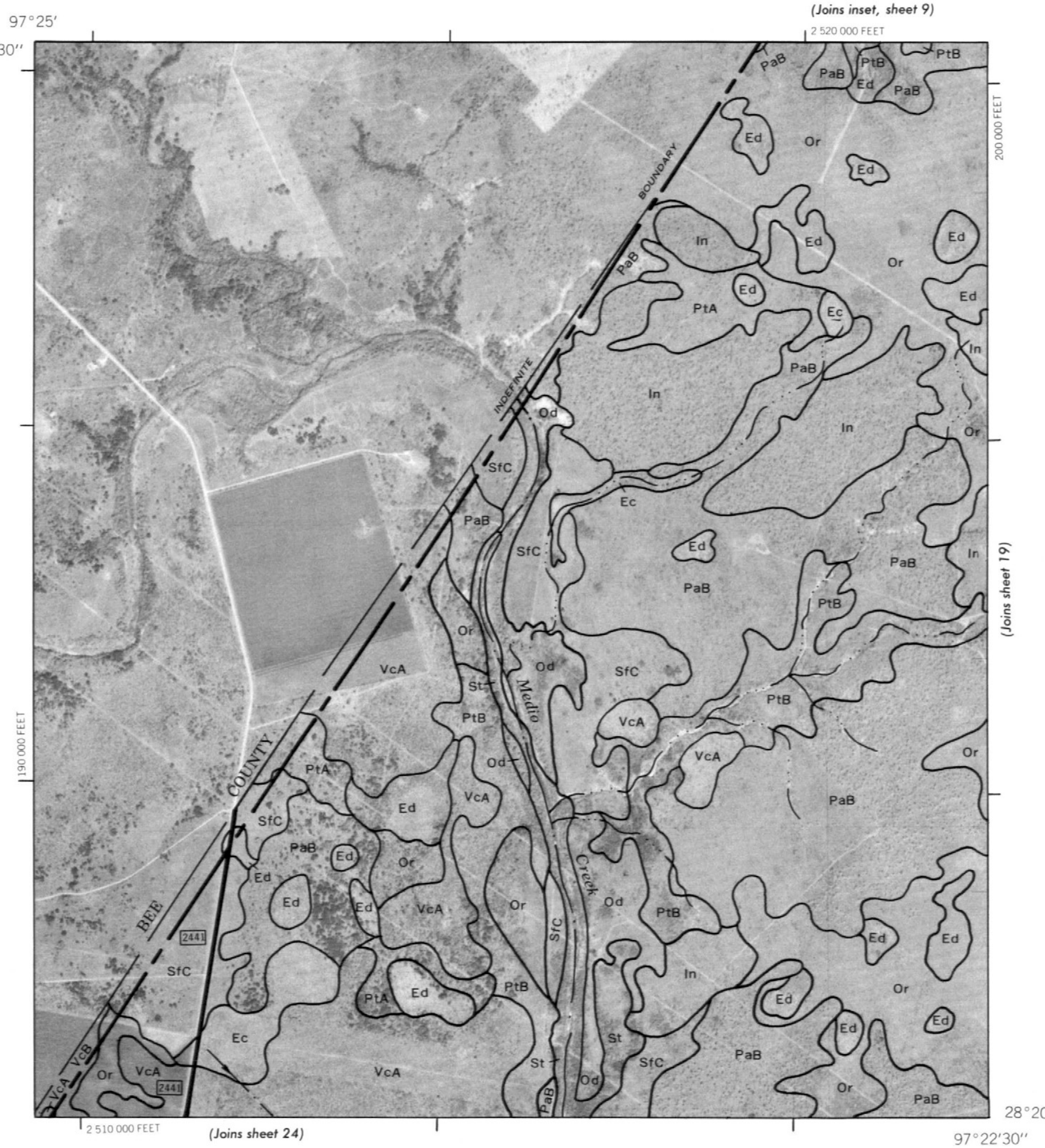
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

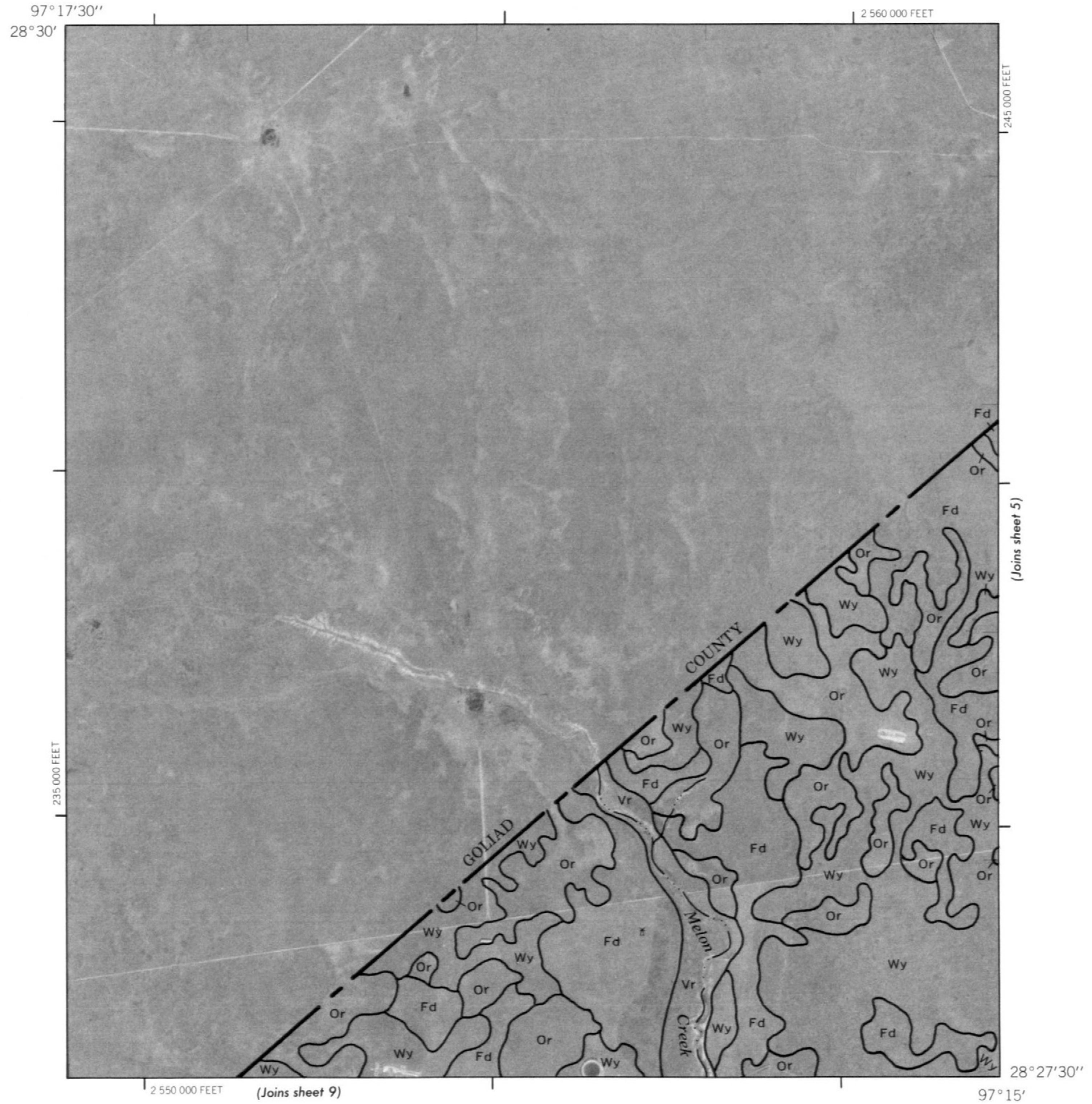


This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

N

REFUGIO COUNTY, TEXAS — SHEET NUMBER 4





5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

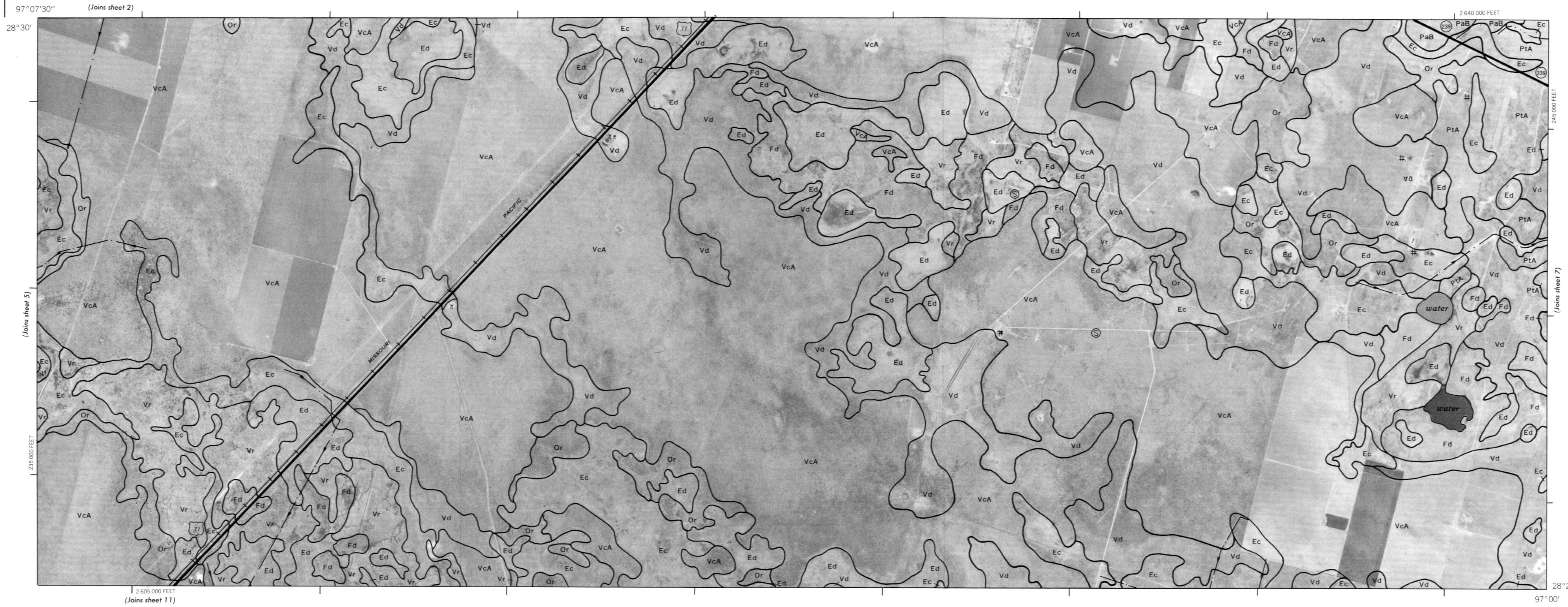
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

N

REFUGIO COUNTY, TEXAS — SHEET NUMBER 6



5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

N

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

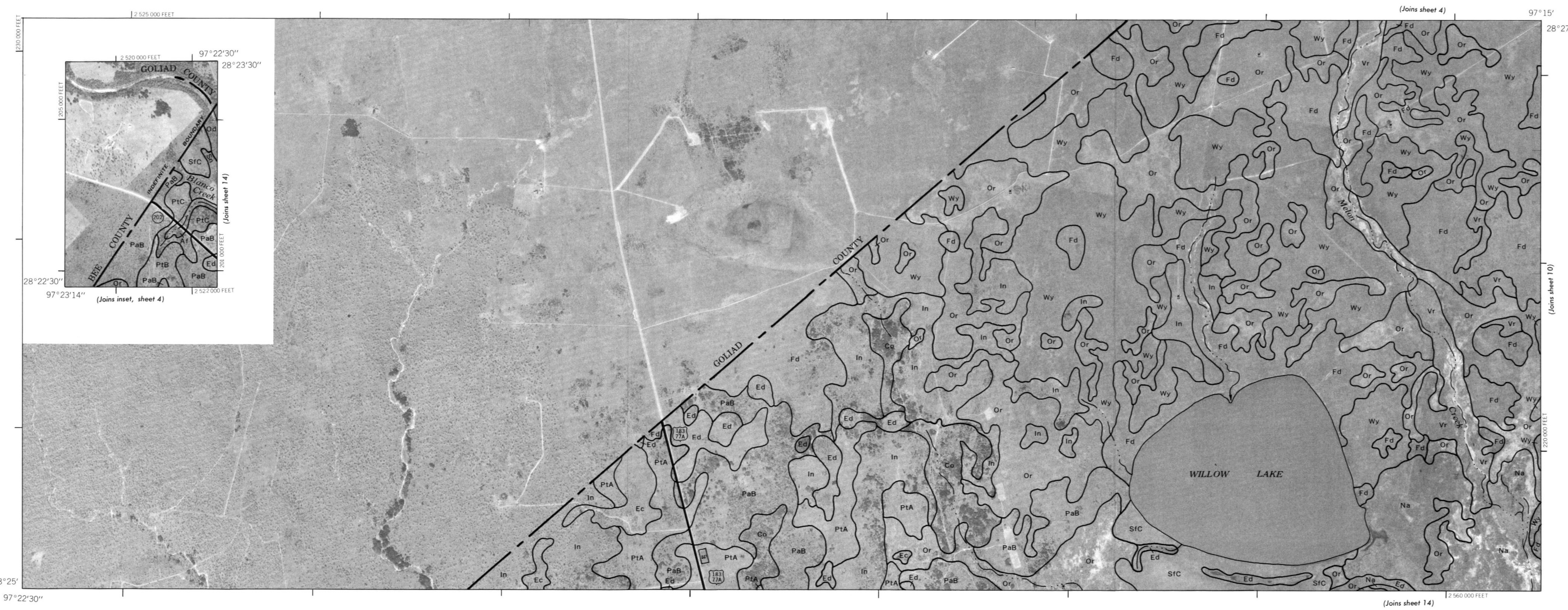
Scale - 1:24000

REFUGIO COUNTY, TEXAS — SHEET NUMBER 8

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

9

N



5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

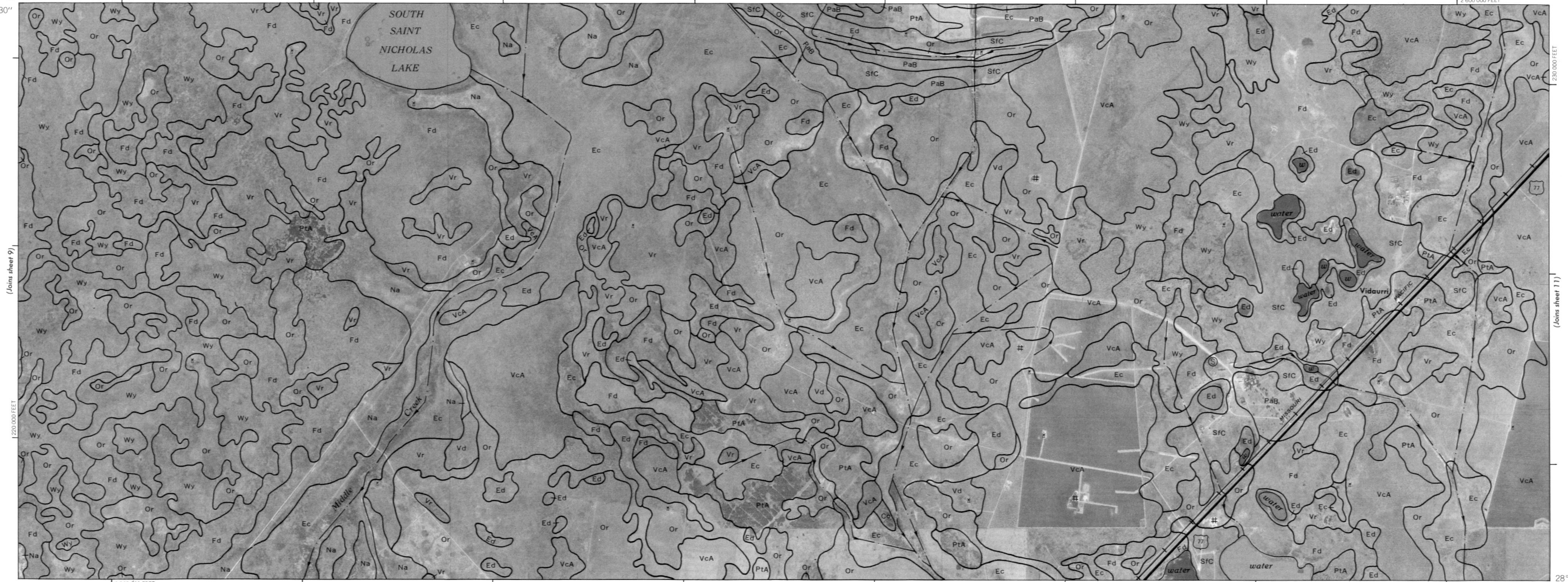
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

N

REFUGIO COUNTY, TEXAS — SHEET NUMBER 10

97°15′ (Joins sheet 5) 2 600 000 FEET

28°27′30″



(Joins sheet 9) (Joins sheet 11)

230 000 FEET

220 000 FEET

2 565 000 FEET (Joins sheet 15)

28°25′

97°07′30″

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

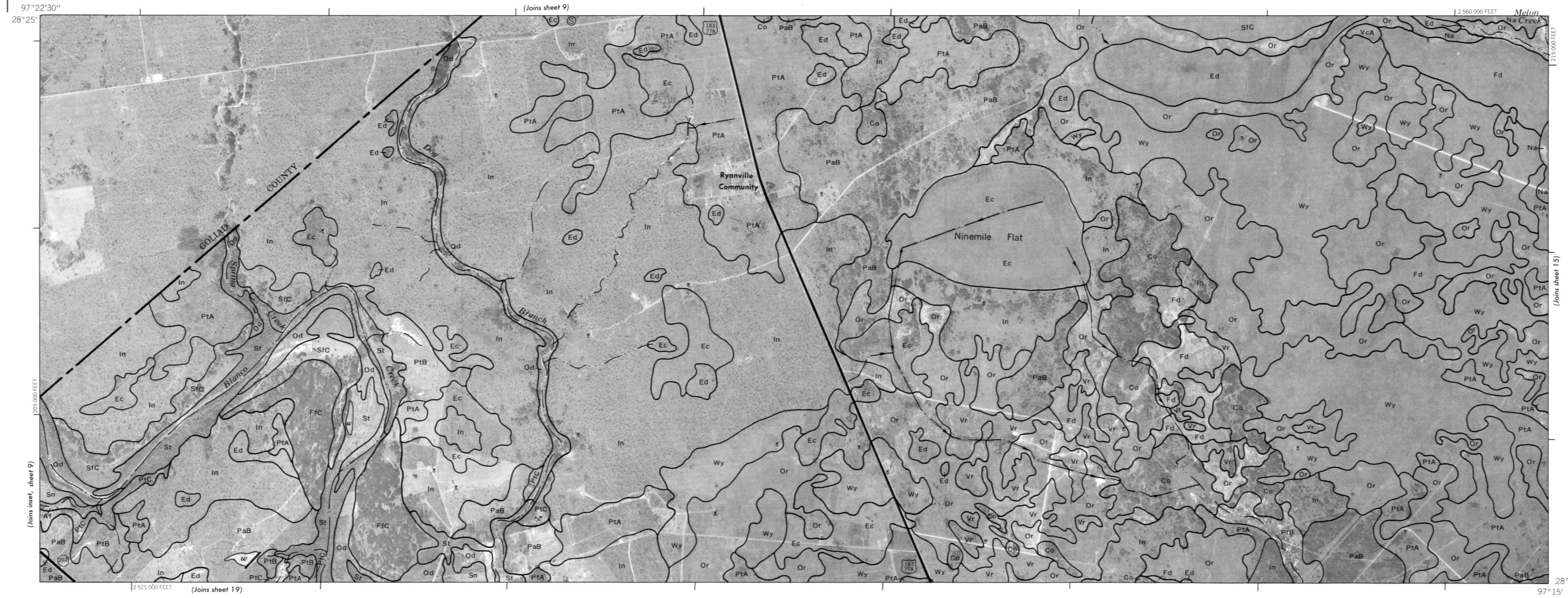
Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

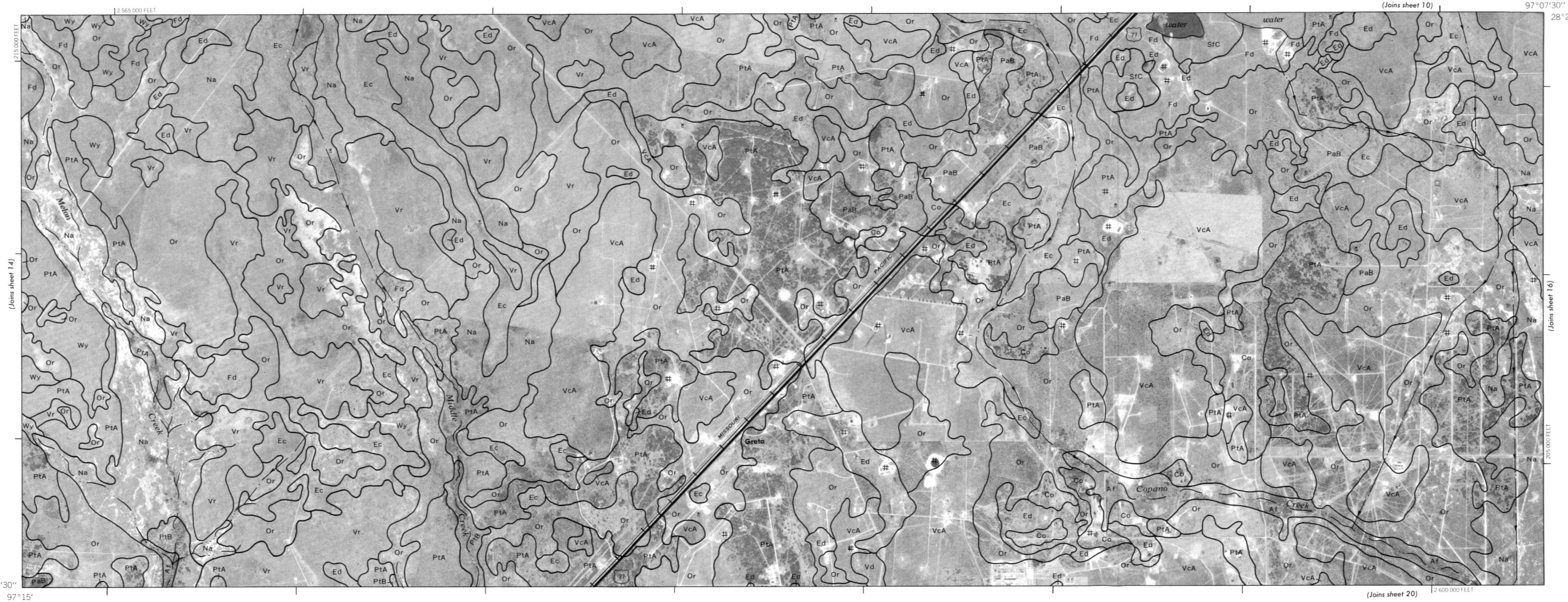
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

15

N



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

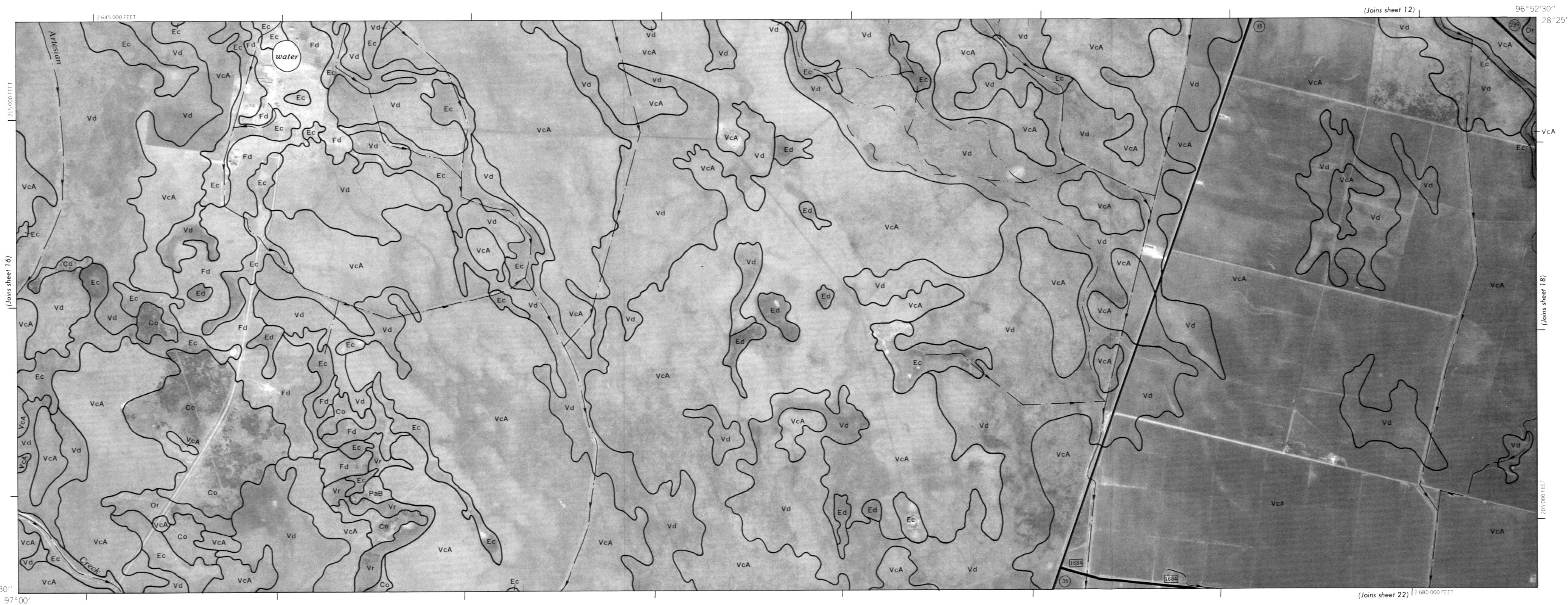
1 .5 0 1 2 3 Kilometers

Scale - 1:24000

REFUGIO COUNTY, TEXAS — SHEET NUMBER 16

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

N



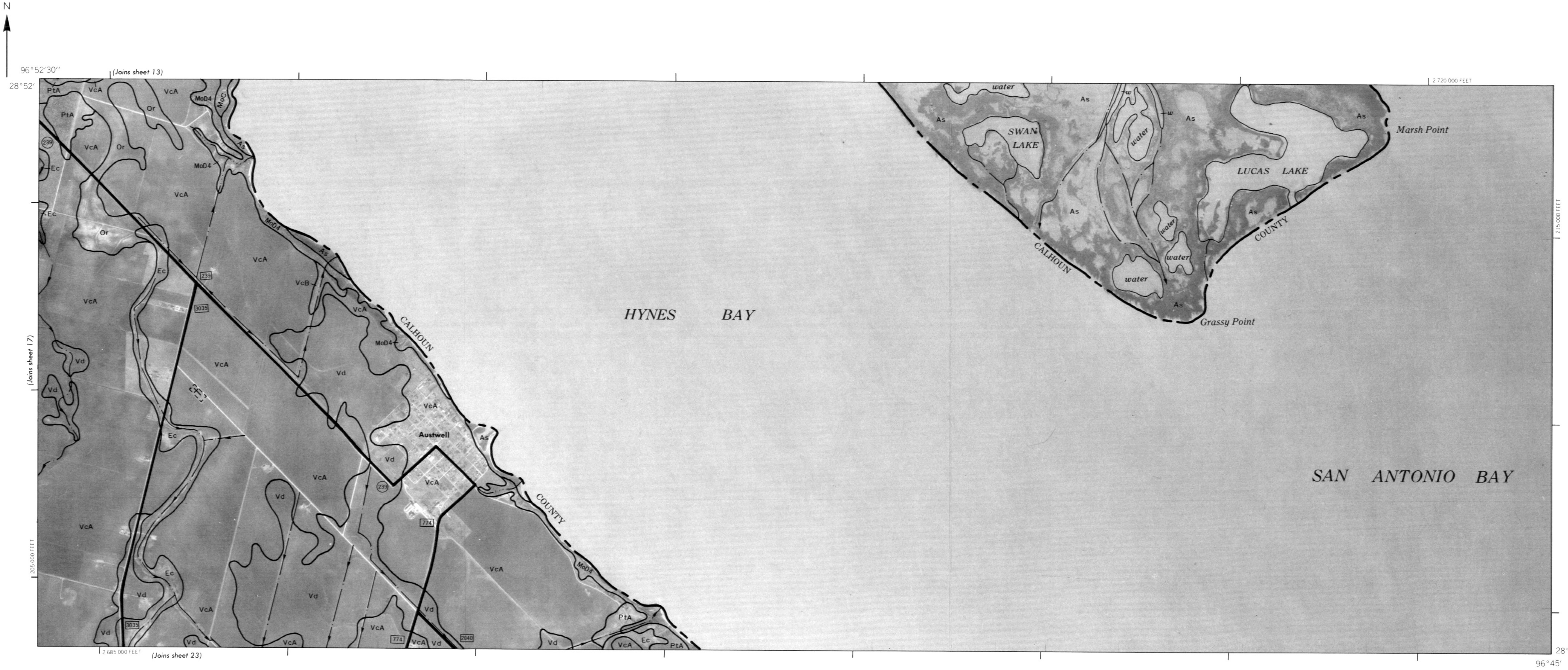
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

REFUGIO COUNTY, TEXAS — SHEET NUMBER 18



5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

19

N

(Joins sheet 14)

2 525 000 FEET

200 000 FEET

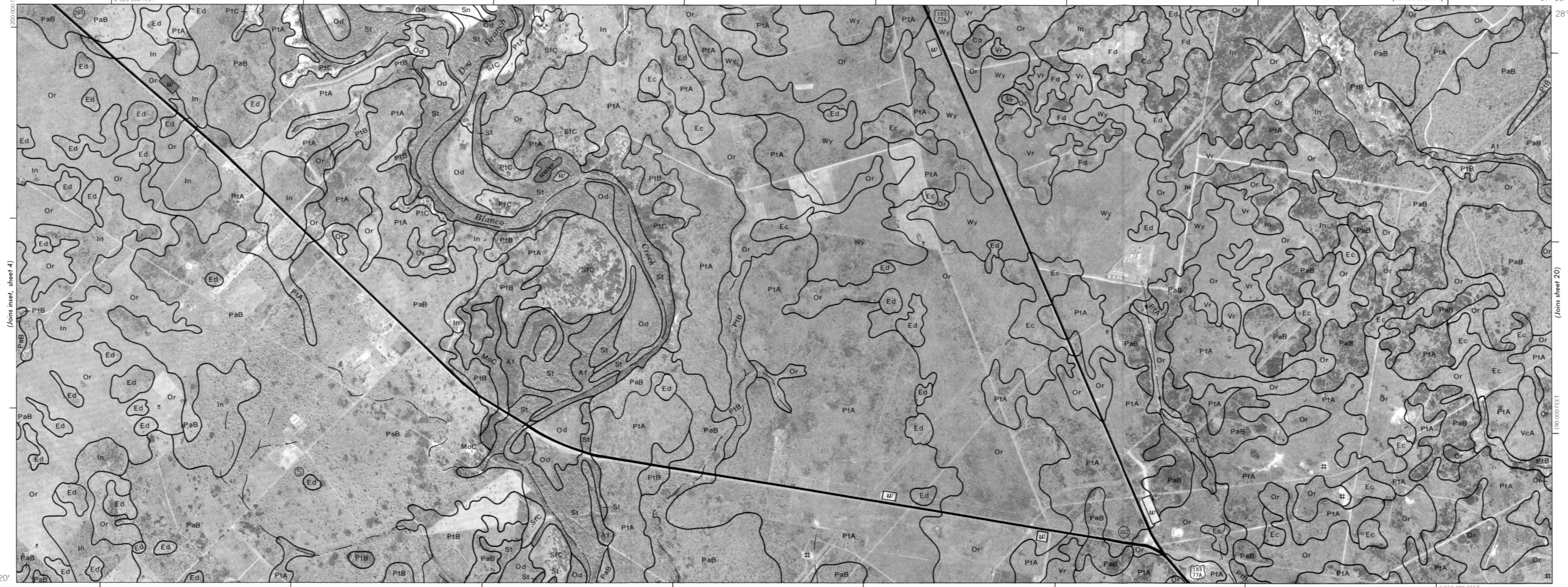
97°15′

28°22′30″

(Joins inset, sheet 4)

(Joins sheet 20)

190 000 FEET



28°20′

97°22′30″

(Joins sheet 25)

2 560 000 FEET

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

N

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

21

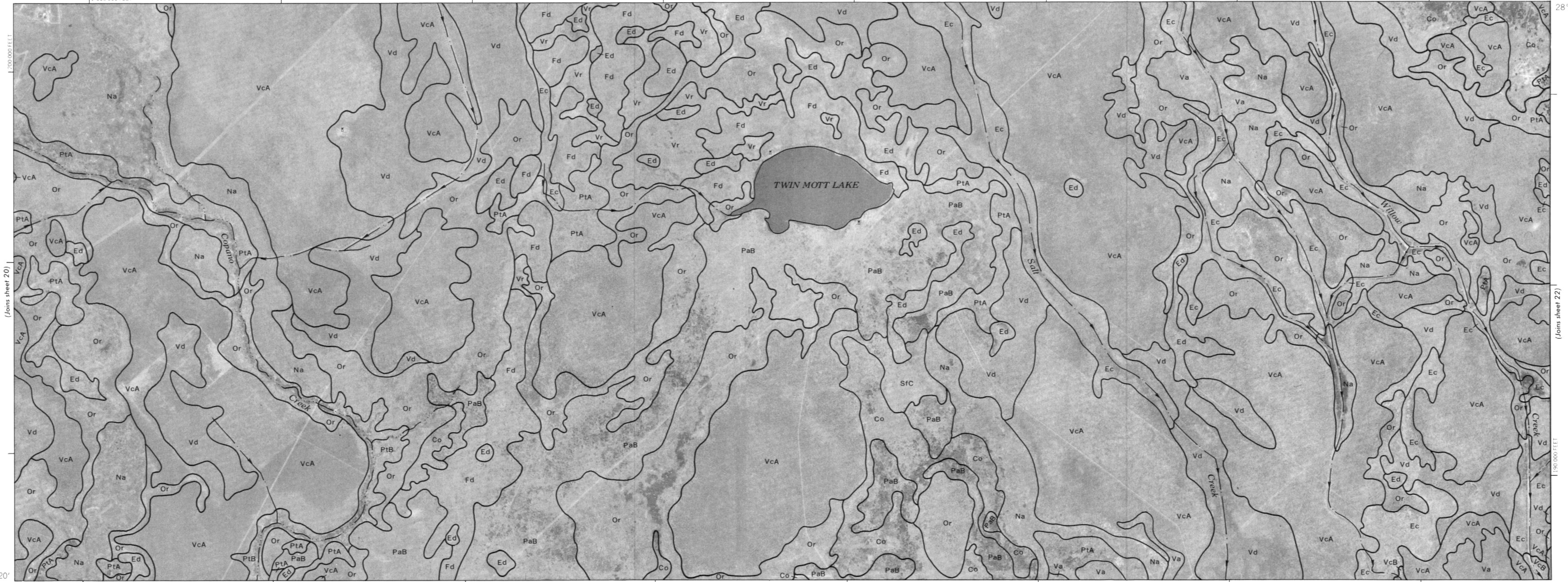
N

(Joins sheet 16)

97°00′

28°22′30″

2 605 000 FEET



(Joins sheet 20)

(Joins sheet 22)

28°20′

97°07′30″

(Joins sheet 27)

2 640 000 FEET

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

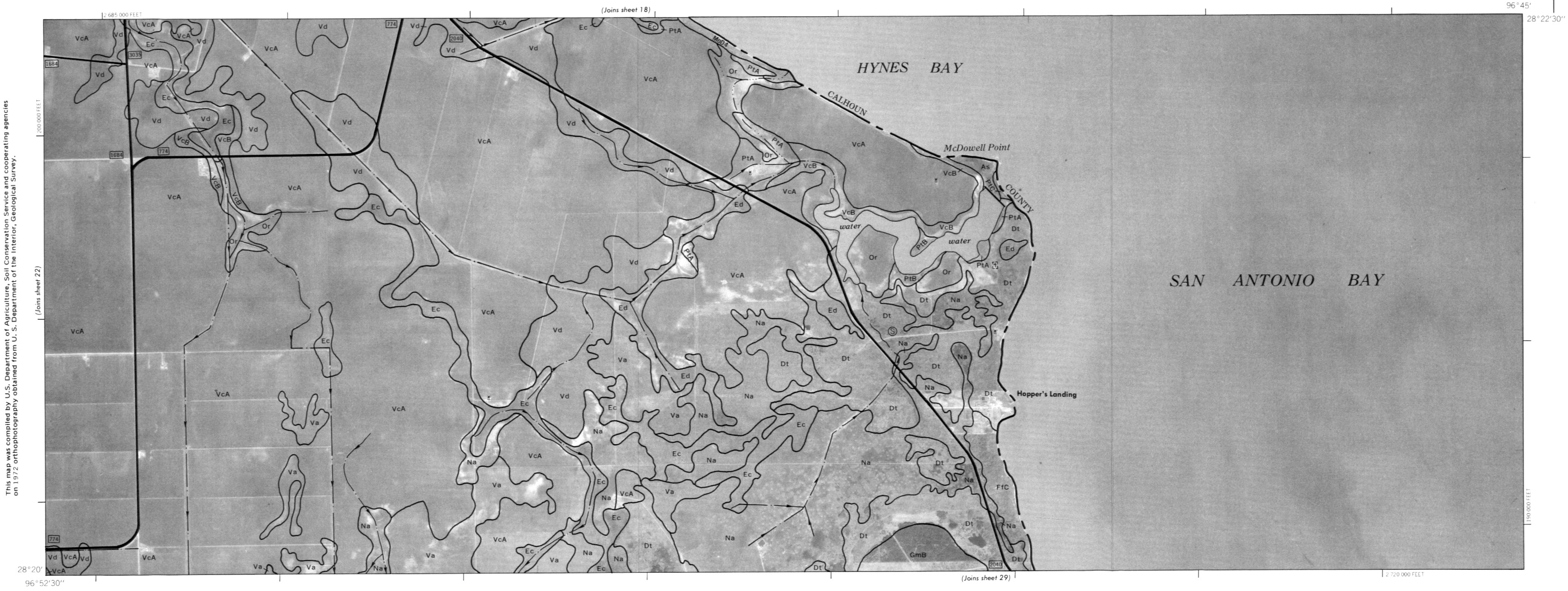
REFUGIO COUNTY, TEXAS — SHEET NUMBER 22

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

N

REFUGIO COUNTY, TEXAS — SHEET NUMBER 24

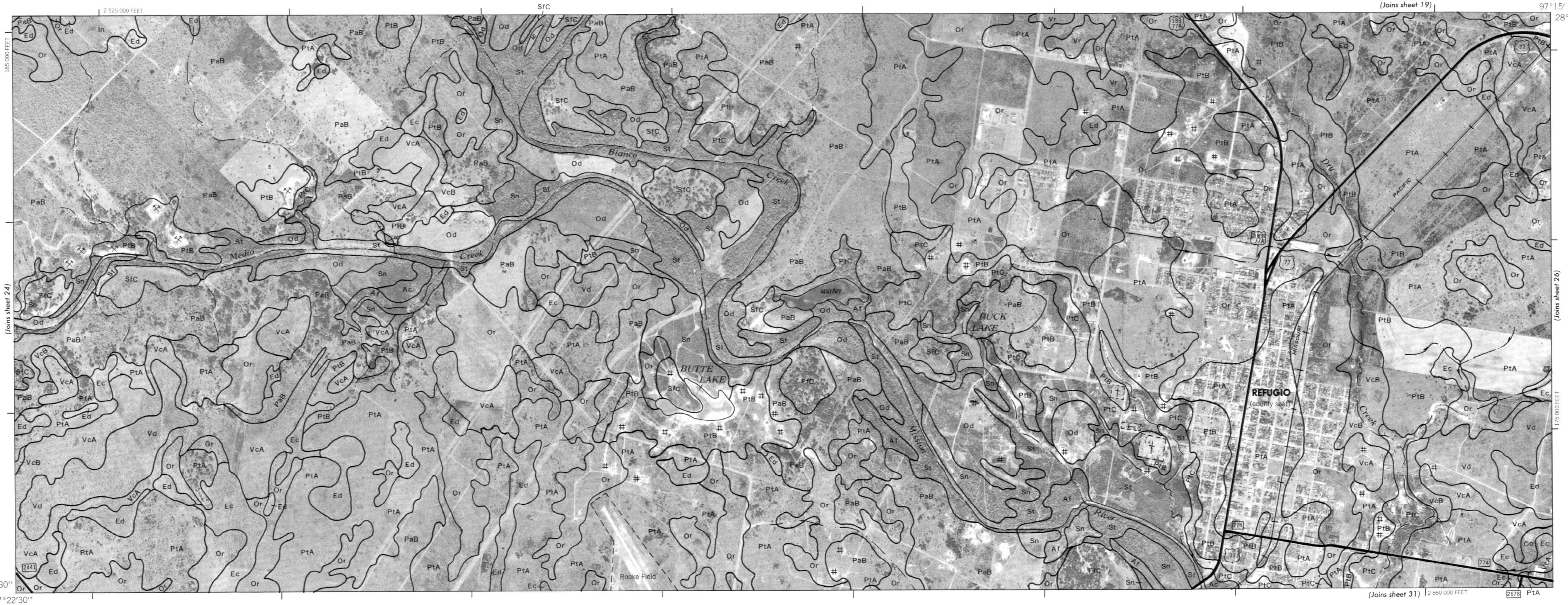
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

N



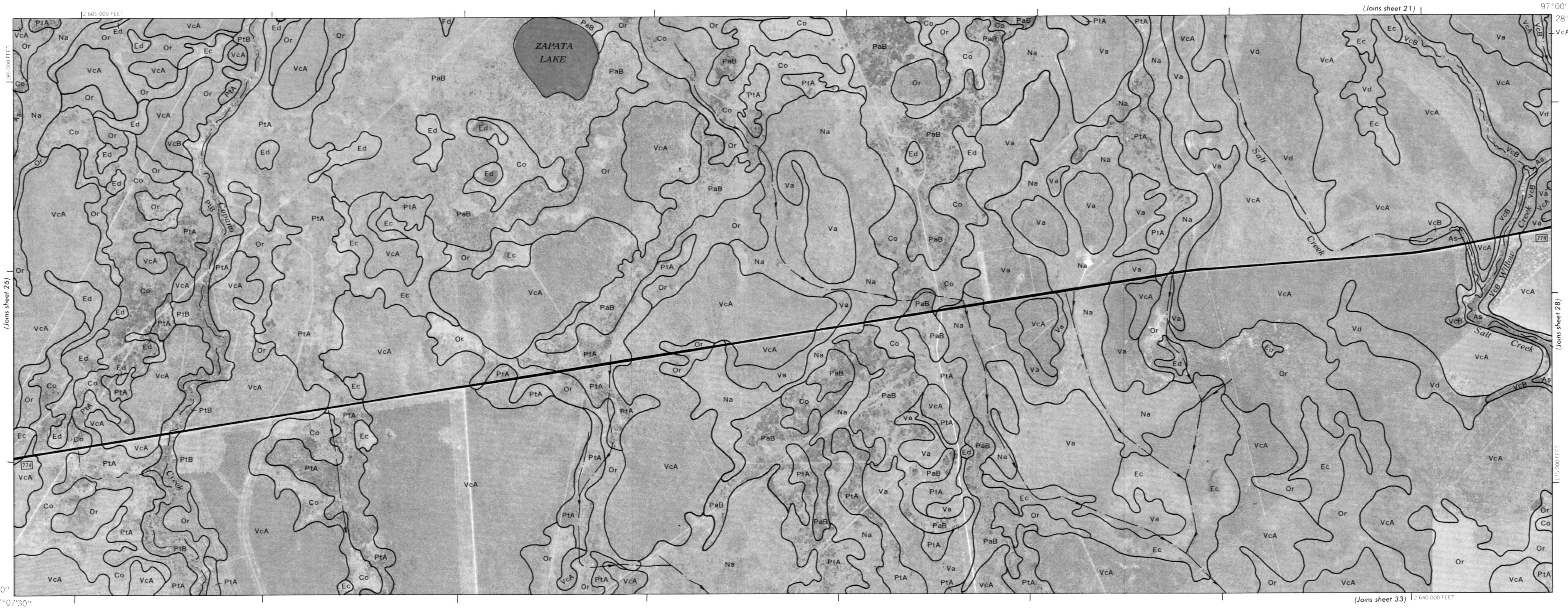
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.



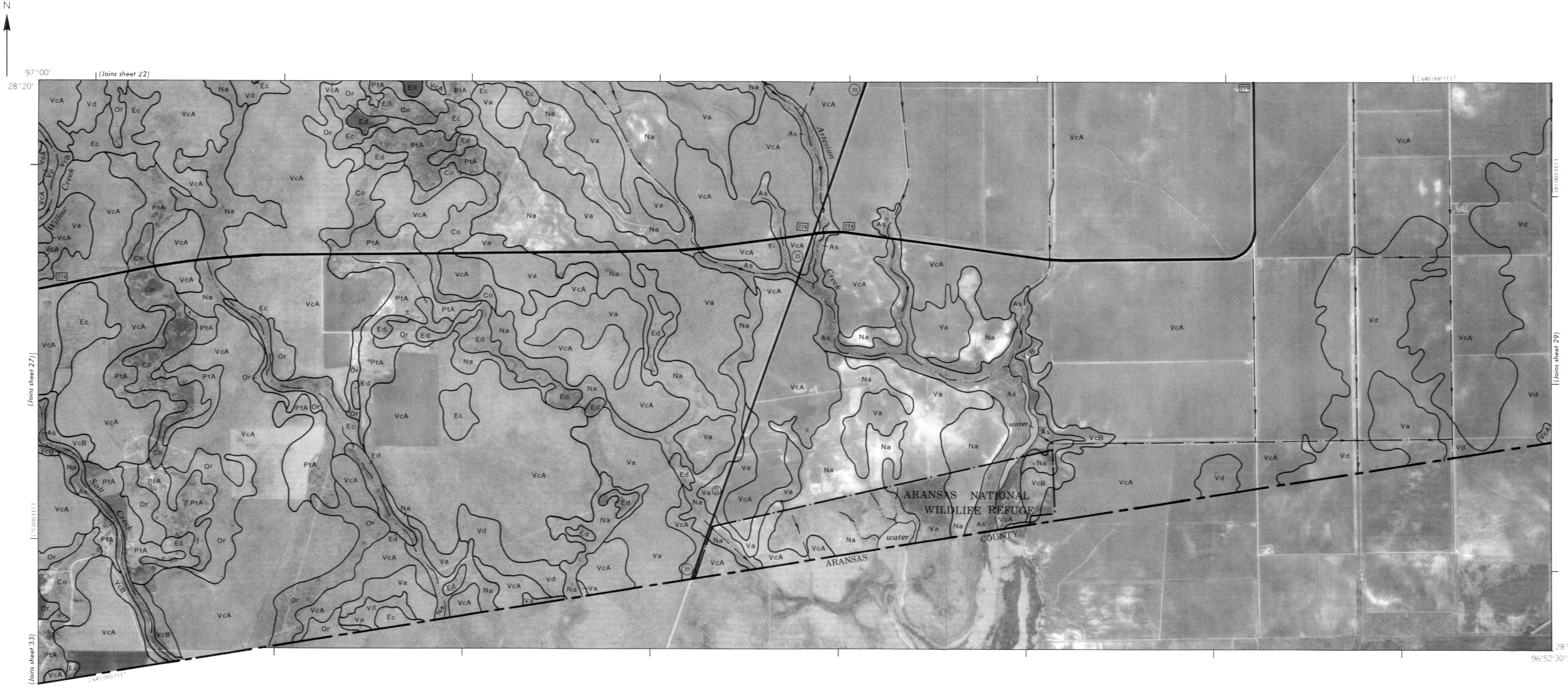
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

REFUGIO COUNTY, TEXAS -- SHEET NUMBER 28



5000 4000 3000 2000 1000 0 5000 10000 Feet

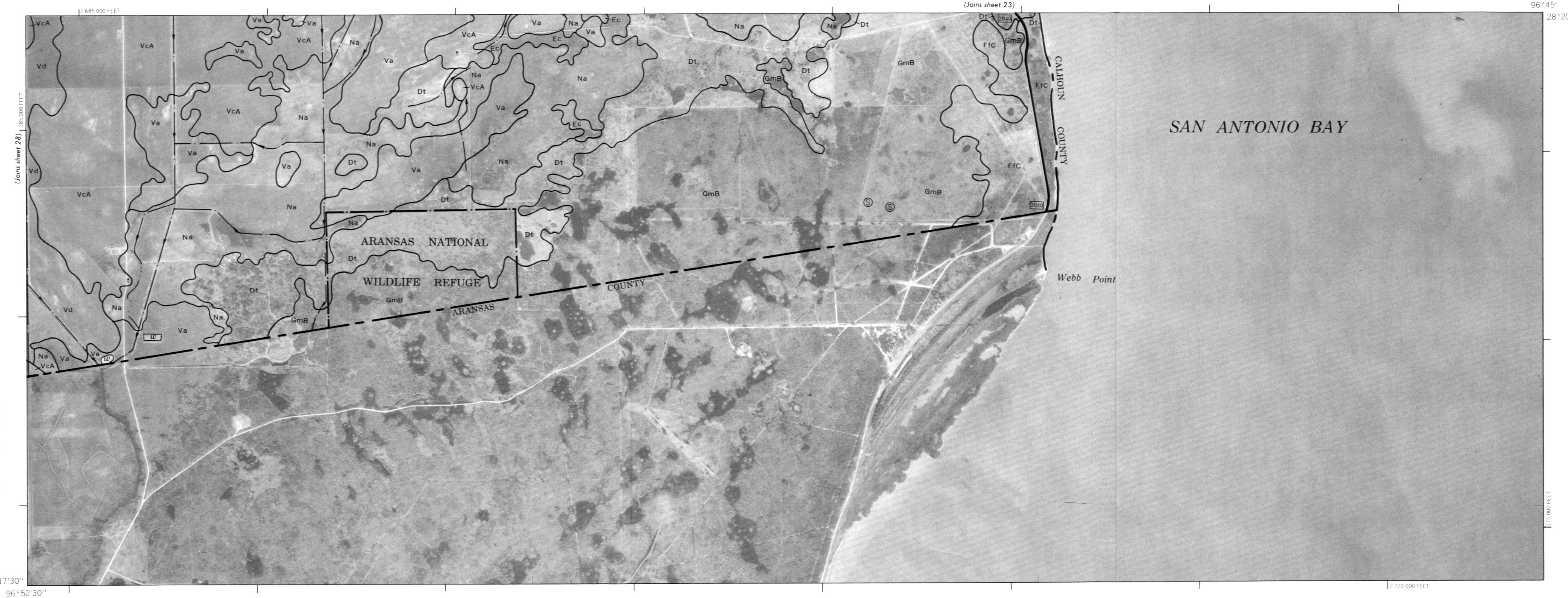
1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

29

N



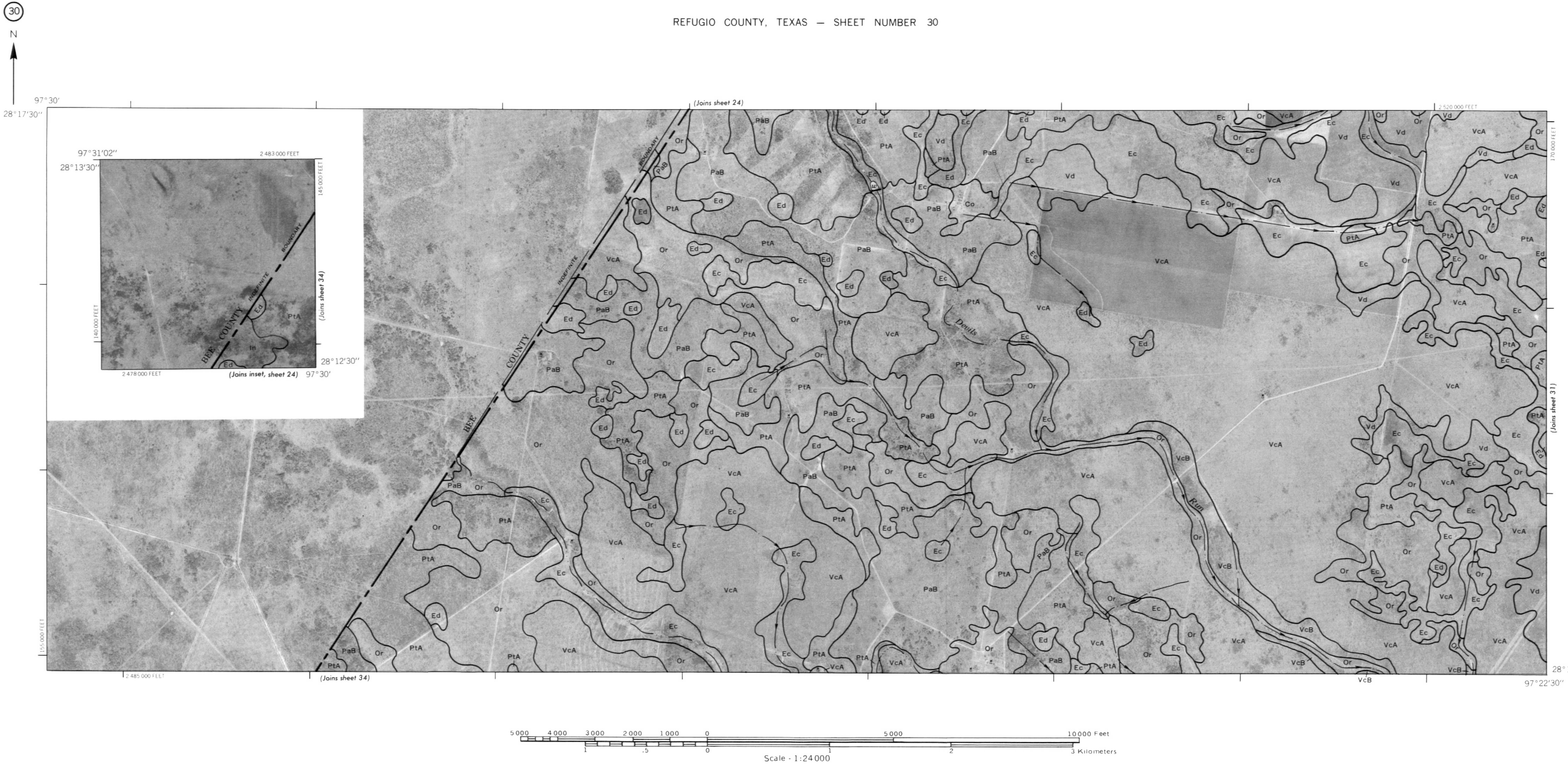
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

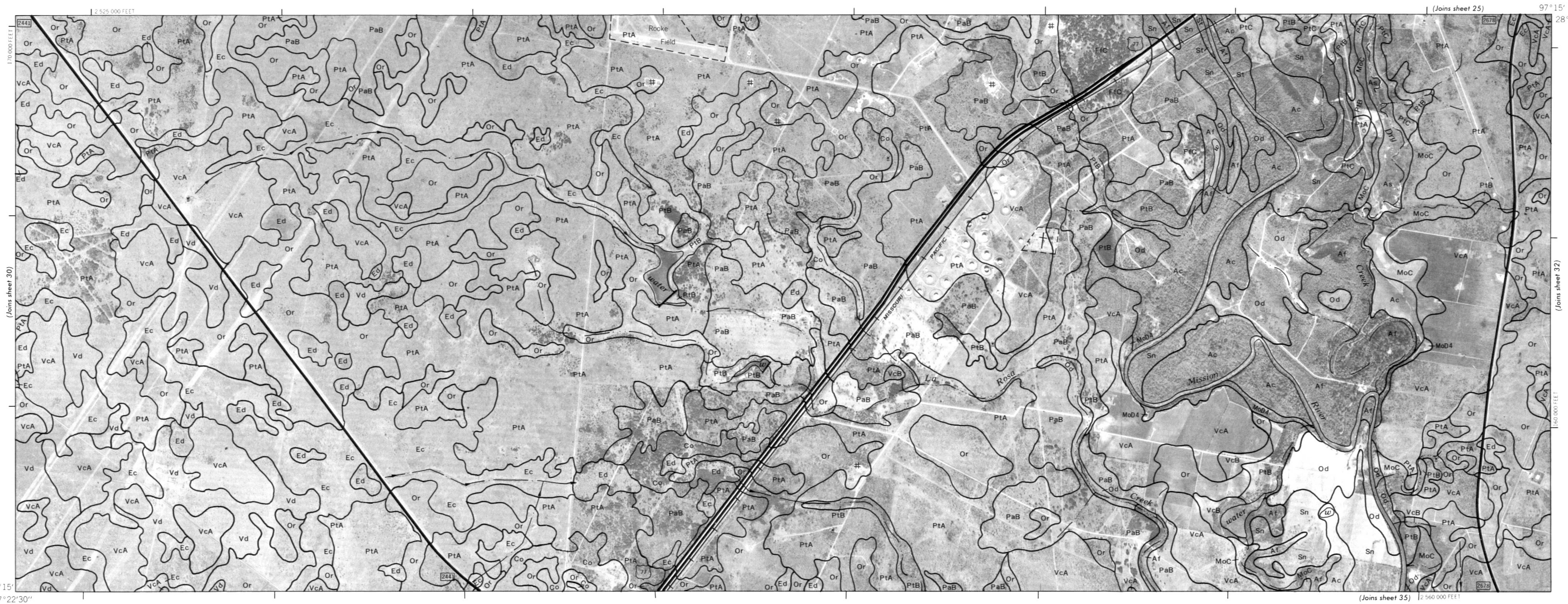
Scale - 1:24000

REFUGIO COUNTY, TEXAS — SHEET NUMBER 30



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

N



5000 4000 3000 2000 1000 0 5000 10000 Feet

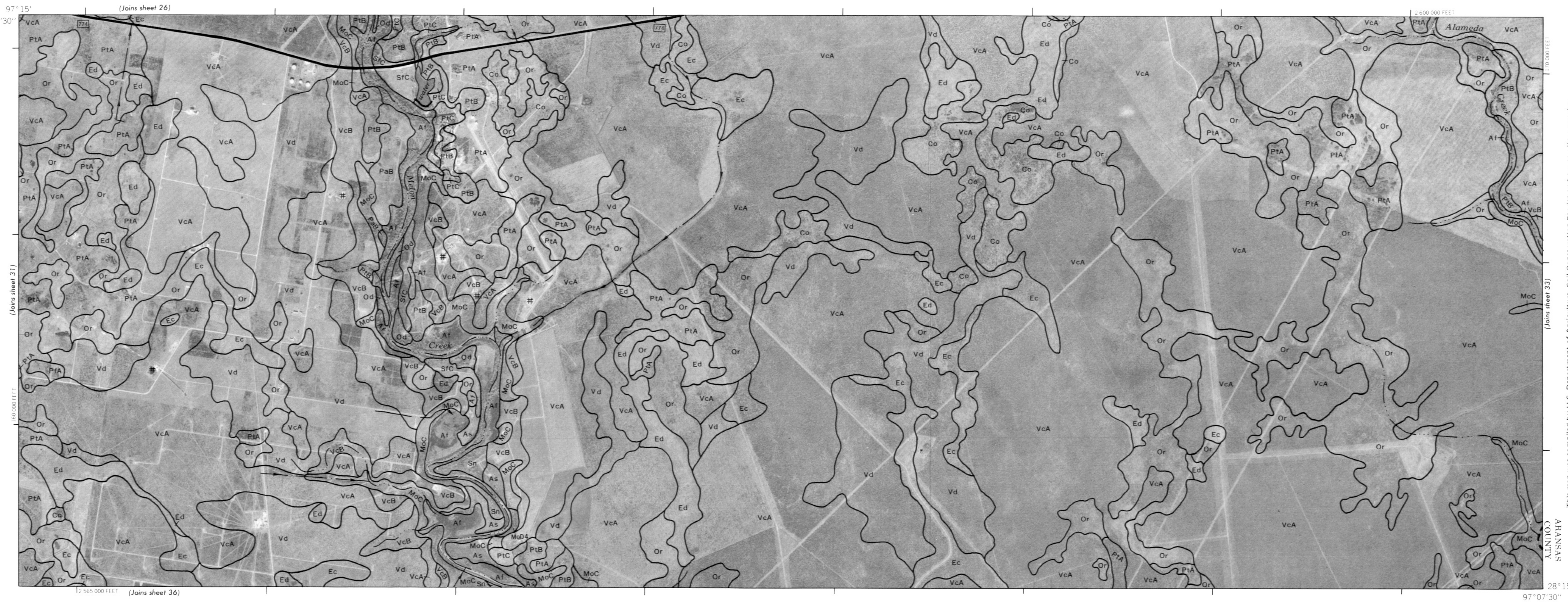
1 .5 0 1 2 3 Kilometers

Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

REFUGIO COUNTY, TEXAS — SHEET NUMBER 32

N



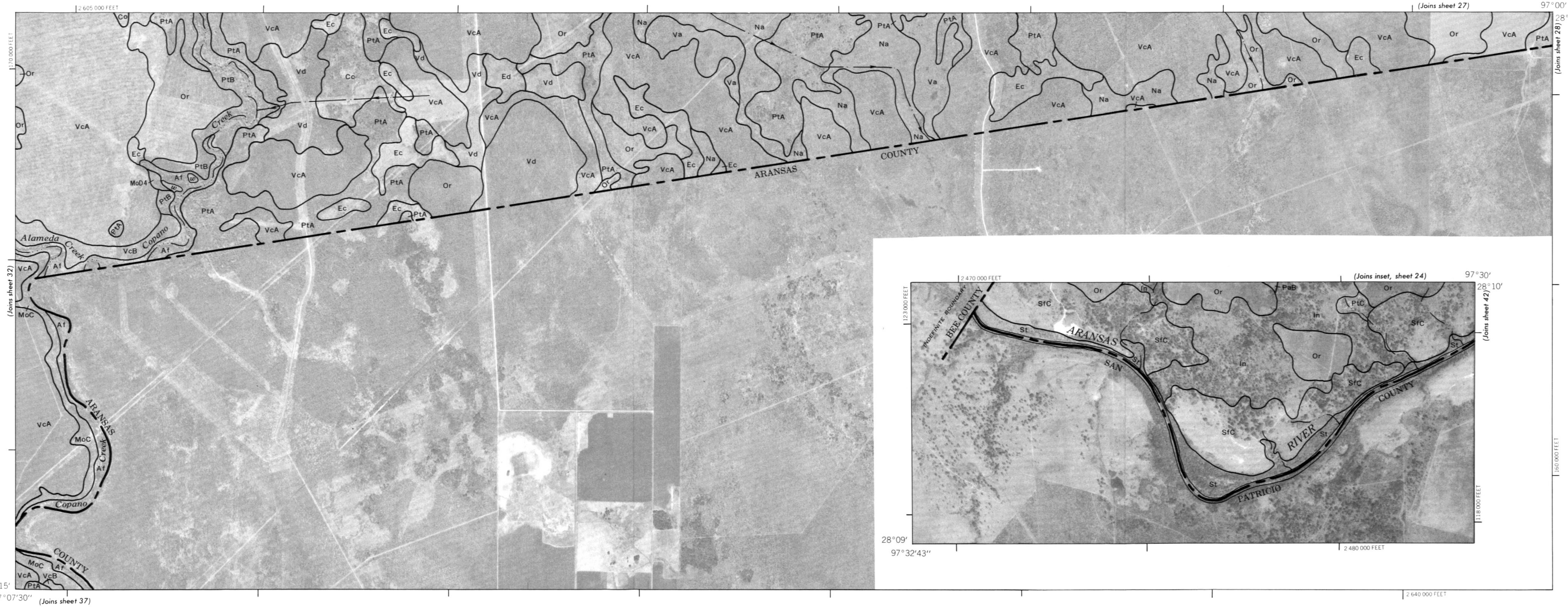
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

N

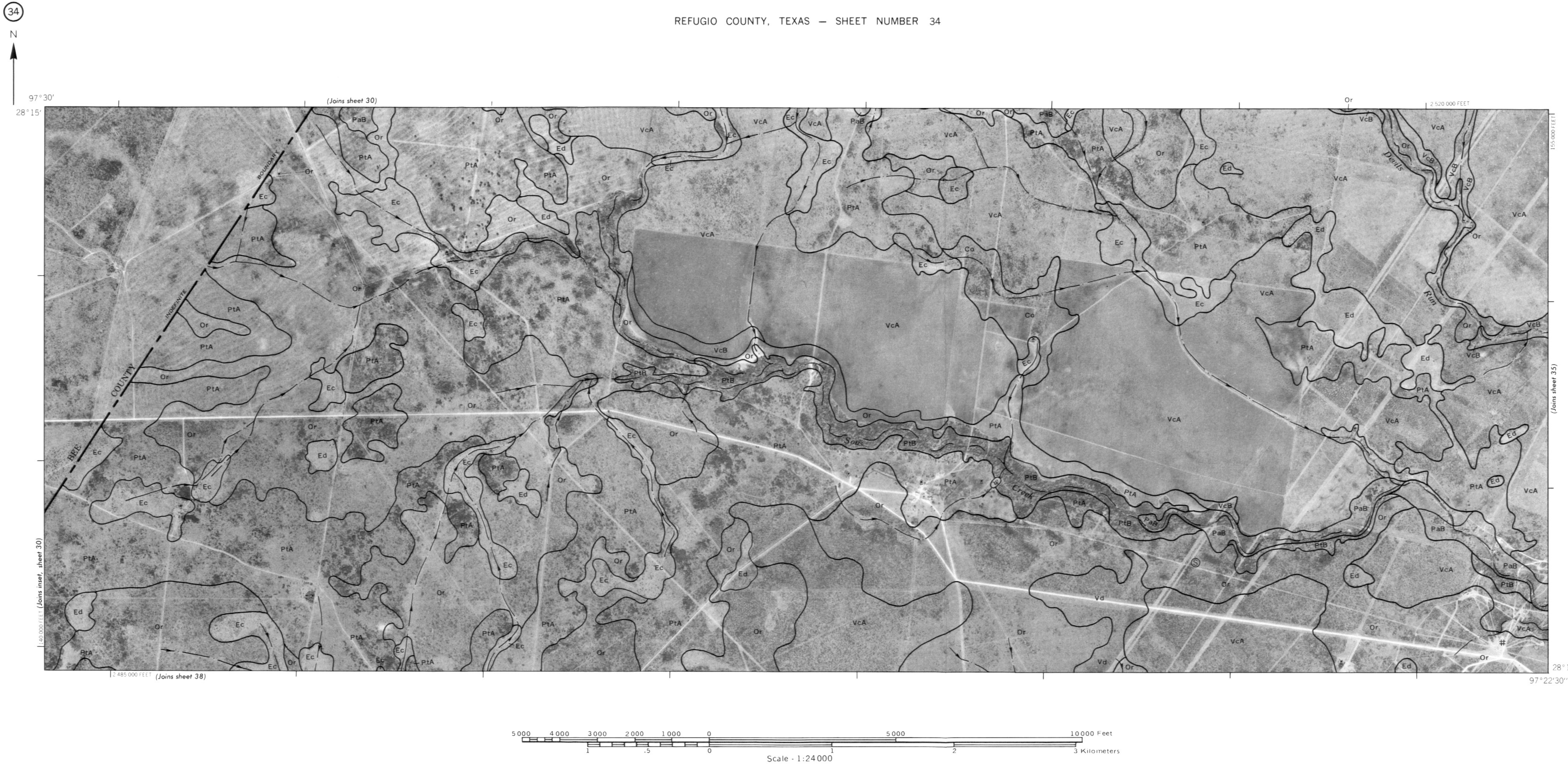


5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

Scale - 1:24 000

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

N

REFUGIO COUNTY, TEXAS — SHEET NUMBER 36

97°15′

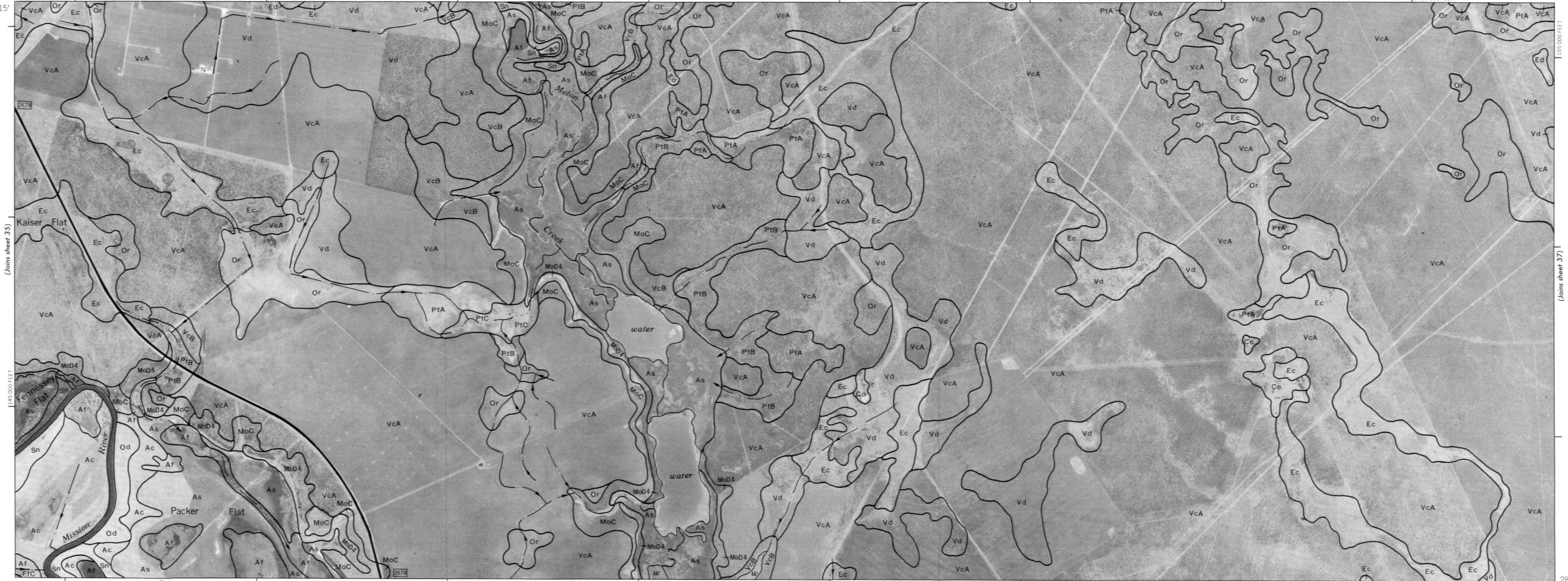
28°15′

(Joins sheet 32)

2 600 000 FEET

155 000 FEET

(Joins sheet 35)



145 000 FEET

(Joins sheet 37)

2 565 000 FEET

(Joins sheet 40)

28°12′30″

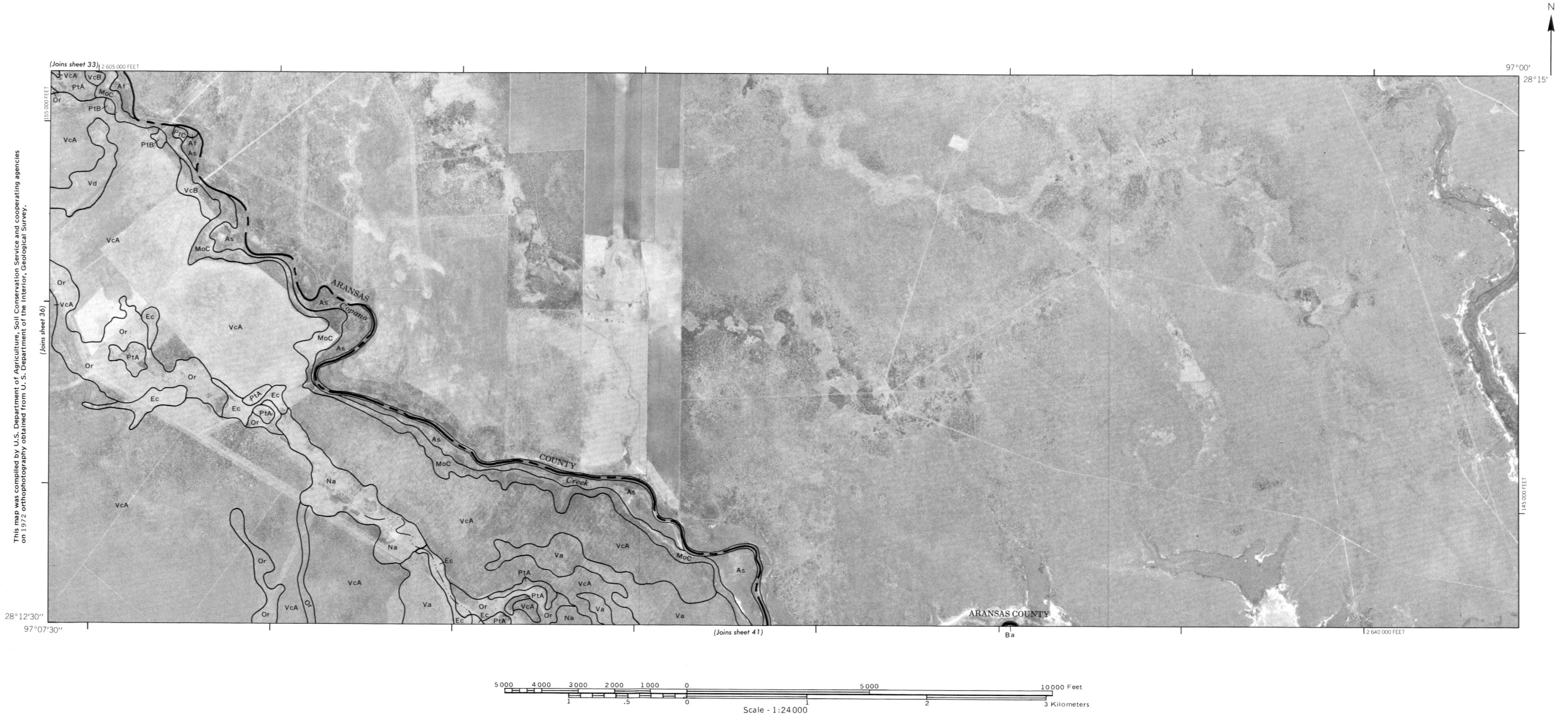
97°07′30″

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

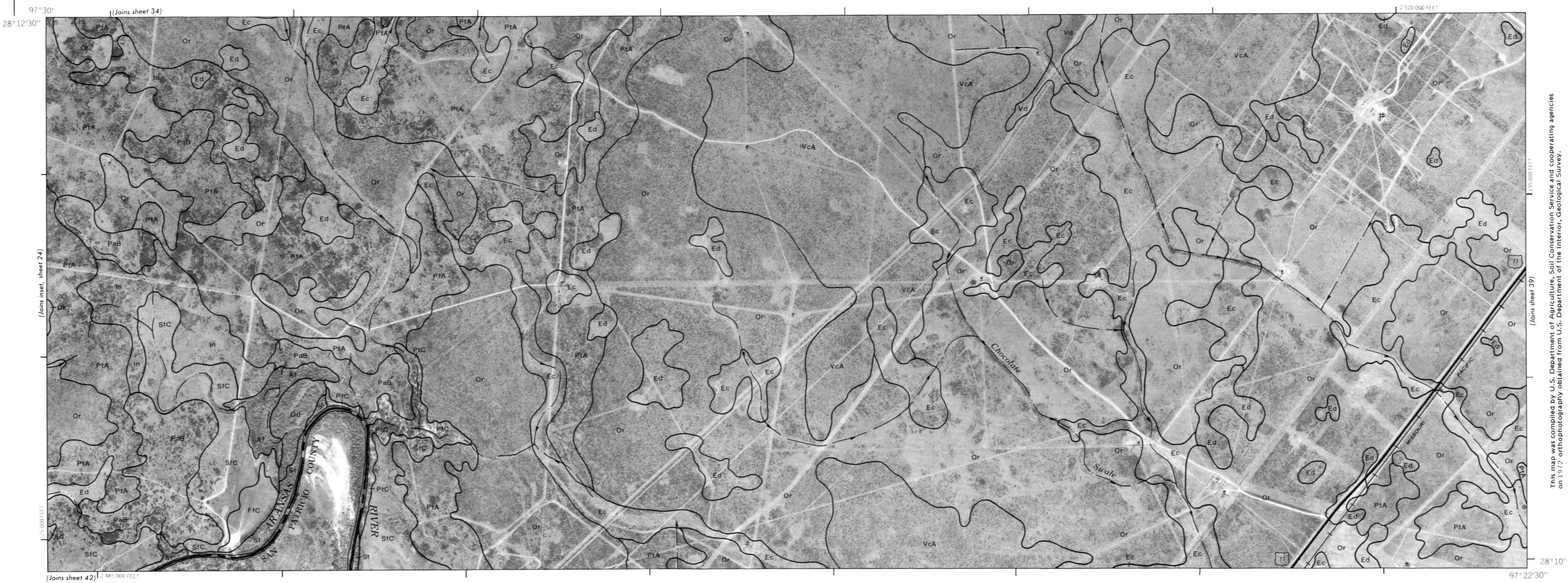
Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.



This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

REFUGIO COUNTY, TEXAS — SHEET NUMBER 38



Scale - 1:24 000

N

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

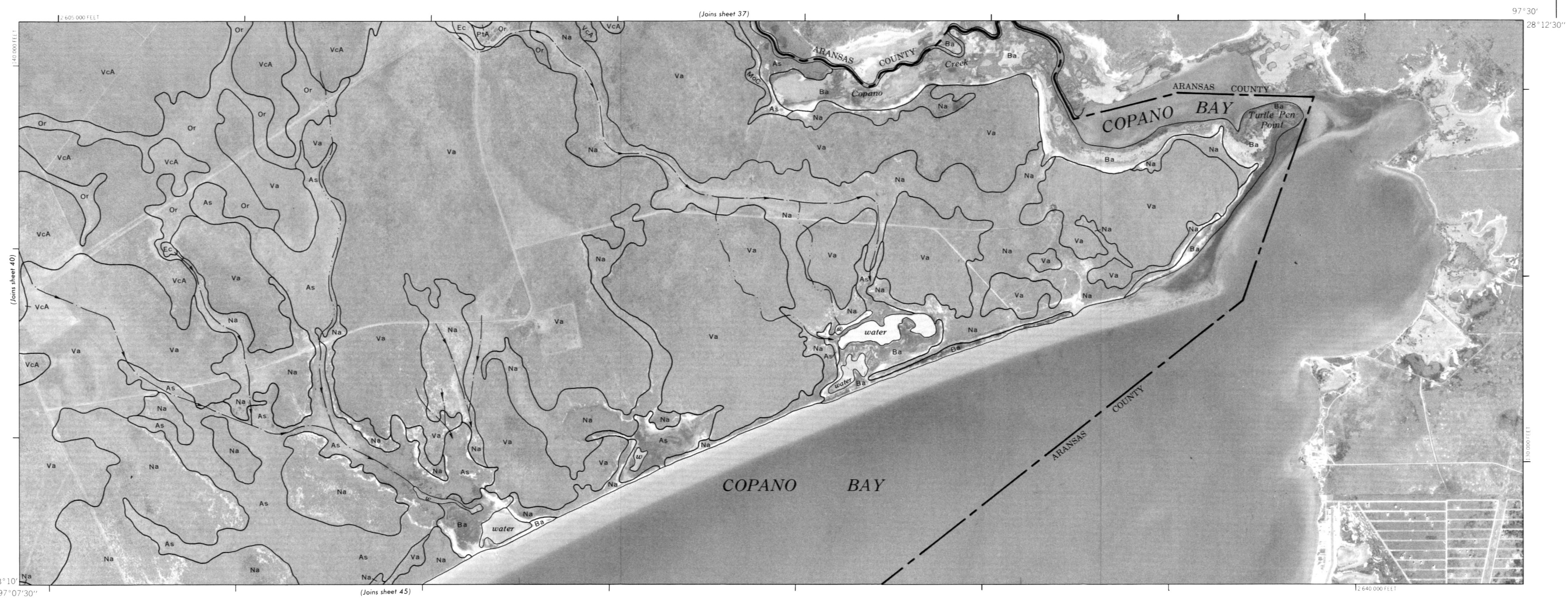
Scale - 1:24 000

REFUGIO COUNTY, TEXAS — SHEET NUMBER 40

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

5000 4000 3000 2000 1000 0 5000 10000 Feet
1 .5 0 1 2 3 Kilometers
Scale - 1:24000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.



Scale - 1:24 000

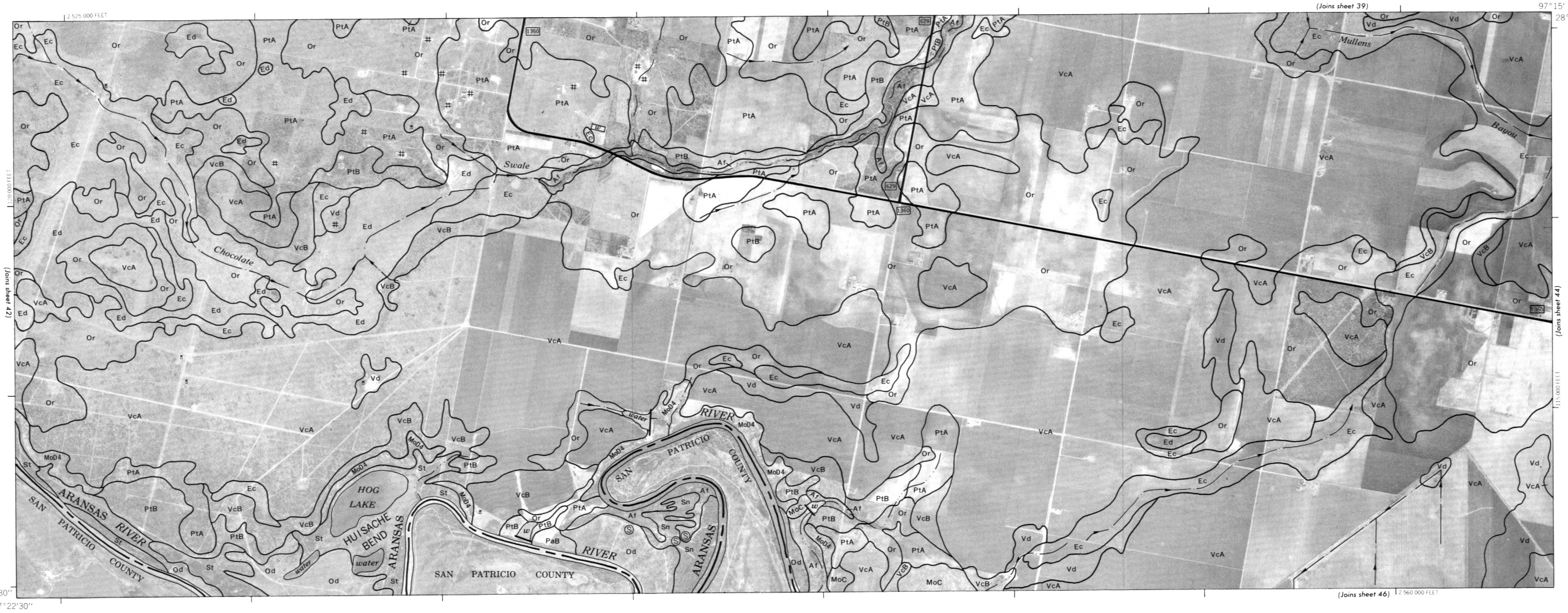
5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

REFUGIO COUNTY, TEXAS — SHEET NUMBER 42

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

This map was compiled by U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

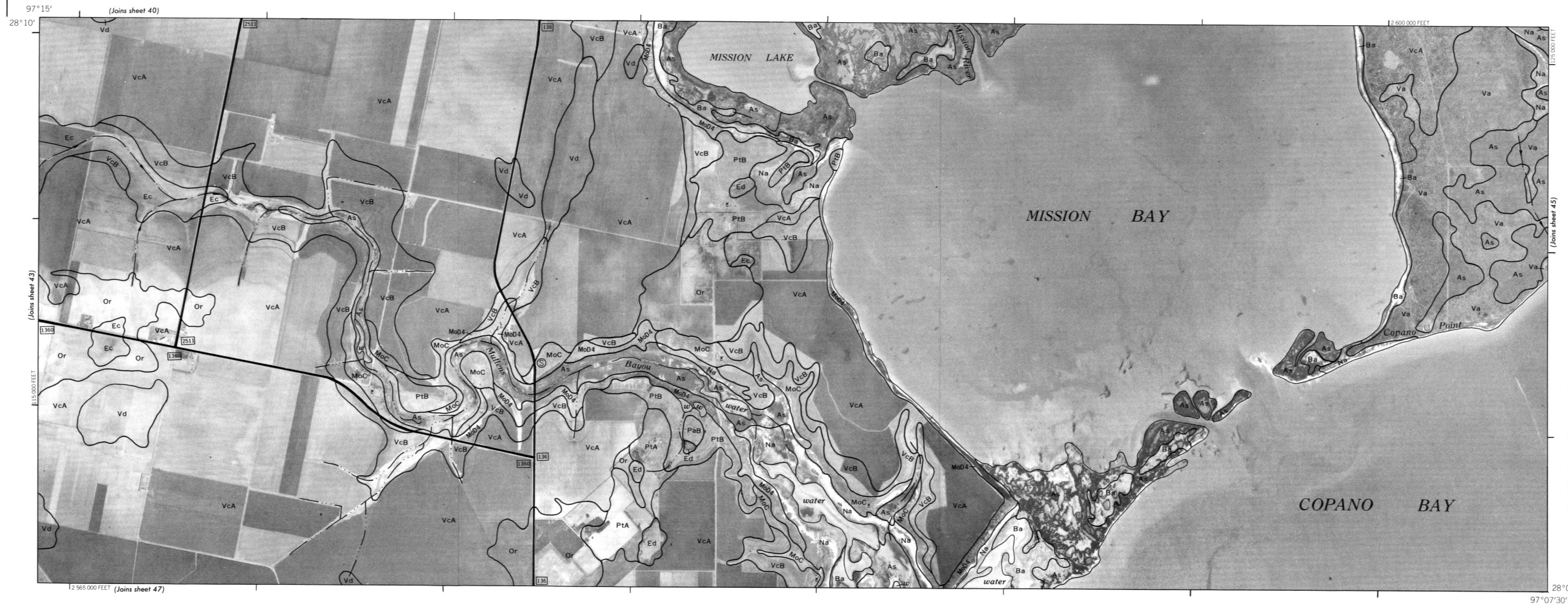


5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000

(44)

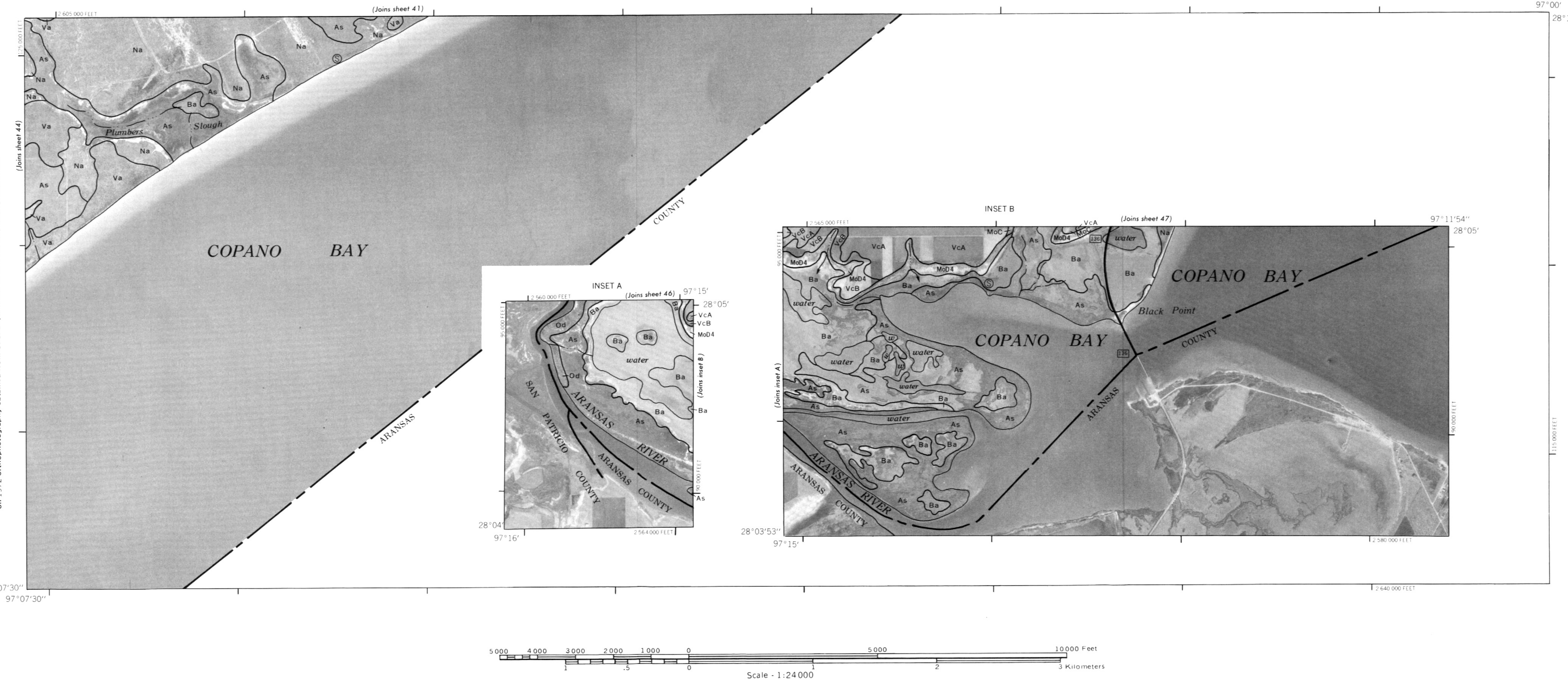


5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24 000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.



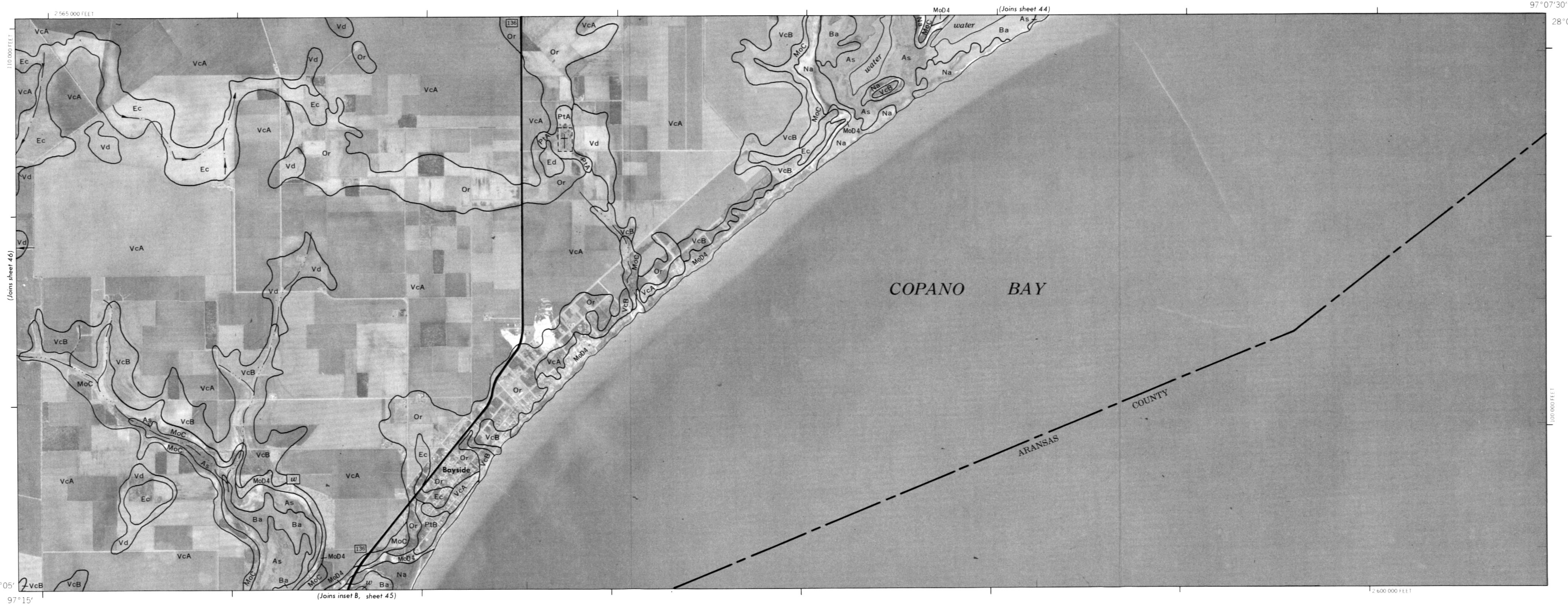
This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

Scale - 1:24 000

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U.S. Department of the Interior, Geological Survey.

This map was compiled by U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies on 1972 orthophotography obtained from U. S. Department of the Interior, Geological Survey.

N



5000 4000 3000 2000 1000 0 5000 10000 Feet

1 .5 0 1 2 3 Kilometers

Scale - 1:24000